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ABSTRACT

This curriculum guide for the K-6 mathematics program for Manitoba schools was developed as part of an overall revision of mathematics programs for Manitoba schools and is designed to articulate with the new guide for grades 7-9. Included in this document are: (1) an overview of formal number work, concepts, and skills, grades 1-6; (2) a general overview of the program, including philosophy, information for parents, and core objectives; (3) notes on program implementation; (4) a chapter on the scope and sequence; (5) individual chapters for each year of the K-6 program, with specific objectives and teaching suggestions; (6) a list of supplementary materials; and (7) a roster of approved textbooks. (MP)

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MATHEMATICS K-6

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1978

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This guide replaces the grades 1-6 guide authorized and issued in 1967 and the revised interim version issued in 1976. It has been developed as part of an overall revision of mathematics programs for Manitoba schools and is designed to articulate with the proposed guide for grades 7-8-9. The final form is based on the interim document and incorporates the suggestions and input of those teachers who field tested the interim version. Mathematics K-6 (1978) becomes the approved provincial guide for mathematics in kindergarten and elementary school, effective September, 1978.

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OVERVIEW OF FORMAL NUMBER WORK AND CONCEPTS AND SKILLS GRADES 1-6

CONCEPTS / SKILLS	COUNTING	NUMBER THEORY						WHOLE NUMBERS				FRACTIONS			DECIMALS			PERCENT	RATIO PROPORTION	ESTIMATING	ROMAN NUMERALS
GRADE		PATTERNS	ODD AND EVEN	FACTORS	MULTIPLES	PRIME AND COMPOSITE	EXPONENTS	PLACE VALUE	ADDITION AND SUBTRACTION	MULTIPLICATION	DIVISION	ADDITION AND SUBTRACTION	MULTIPLICATION	DIVISION	ADDITION AND SUBTRACTION	MULTIPLICATION	DIVISION				
1	to 10 by 2's 3's 4's 5's	concrete action pictorial						readiness	1 digit no regrouping	readiness	readiness									re measurement readiness	
2	to 100 by 2's 3's 4's 5's 10's							to 99	2 digits no regrouping	basic facts to 20	basic facts to 20									re measurement	
3	to 999	numerical	up to 20	of products to 40		readiness		to 999	3 digits with and without regrouping	basic facts to 40 2 digits times 1 digit	basic facts to 40									re addition and subtraction problems	I to XX
4			sums of	of products to 100		to 21		to 6 digits	4 digits with and without regrouping	master all basic facts 4 digits times 2 digits	master all basic facts 3 digits by 1 digit	like denominators sums < 1								re multiplication and division problems	I to C
5				common factor	of a given number common multiples	to 100		to 9 digits including zero as a place holder	5 digits with and without regrouping	4 digits times 3 digits	6 digits by 2 digits	proper improper mixed like and unlike denominators sums — and > 1			tenths hundredths thousandths or combinations						I to M
6				greatest common factor	lowest common multiple		application in — factoring — place value — expanded notation — measurement	to 10 digits including zero as a place holder	6 digits with and without regrouping	to a total of 8 digits	6 digits by 3 digits		fraction times whole number mixed number times whole number			decimal times whole number	by converting divisor to a whole number	as fraction with denominators of 100 as a 2 place decimal	ratio format comparing 2 ratios		

ongoing
development
and
maintenance
to achieve
the
objectives
stated
in the
guide

for kindergarten see page 23

OVERVIEW OF FORMAL NUMBER WORK AND CONCEPTS AND SKILLS GRADES 1-6

↓

ongoing development and maintenance to achieve the objectives stated in the guide

GEOMETRY									MOTION GEOMETRY	GRAPHING	PROBLEM SOLVING	MEASUREMENT								
3-D SHAPES	2-D SHAPES	LINES	REGULAR SHAPES	ANGLES	TRIANGLES	QUADRILATERALS	CONGRUENCY	SYMMETRY				LINEAR	AREA	VOLUME	CAPACITY	MASS	TEMPERATURE	TIME	TELLING TIME	MONEY
ball can box cone	square rectangle circle triangle							recognize		one to one concrete concrete bar pictograph	oral	non standard units standard units	readiness	readiness	readiness	readiness	readiness	day week year	to the hour	coins
↓	↓							↓			oral and written	↓	readiness	readiness	non standard units standard units	non standard units standard units	read and interpret Celsius thermometer	↓	to the quarter hour	coins and dollar bill
↓	similarities differences draw rectangle square	parallel straight curved	3 4 5 6 sides draw a line segment					line of symmetry		one to one bar graph	begin developing systematic approach	↓	non standard units standard units	non standard units	↓	↓	↓	yesterday tomorrow	to five minutes	problems with money
sphere cylinder cube cone prisms	↓	measure	↓	meaning			re shapes	axis of symmetry	slides flips turns	one to many concrete concrete bar pictograph bar graph	one step	↓	↓	standard units	add and subtract units	↓	↓	↓	to one minute	↓
↓	↓	line segments open and closed curves perpendicular lines	8 sides	compare	right		re line segments	↓	identify slide flip turn	ordered pairs	two step	↓	↓	↓	↓	add and subtract units	↓	SI date format digital clock 24 hr clock	↓	↓
↓	↓	↓	↓	name and measure	scalene isosceles equilateral	types	↓	polygons and symmetry	test for congruency after slide flip turn	first quadrant interpret simple circle graph	↓	↓	↓	discover formula	↓	↓	↓	↓	↓	↓

GENERAL OVERVIEW OF THE PROGRAM

GENERAL OVERVIEW OF THE PROGRAM

This section has been inserted to provide a general description and summary of the objectives of the Mathematics K-6 program as a whole. "General Information of Interest to Parents" is designed to assist teachers in answering parents' questions about the program and the teaching of mathematics to children.

Philosophy of the Elementary Mathematics Program

The 1978 program in mathematics in Manitoba for kindergarten through grade 6 stresses a balance between the understanding of what mathematics is and the development of sound mathematical skills.

The Number System

The program suggests that the above will be best achieved by active involvement of children with objects and experiences keeping in mind the developmental stages of learning.
(Objects ⟶ pictures ⟶ symbols.)

The program consists of four basic topics: number development, geometry, measurement and graphing. These topics are to be developed continuously throughout the years and integrated where applicable, rather than developed as separate units.

There is strong emphasis on language development, maintenance, and reinforcement of skills which include drill, problem solving, mental arithmetic, estimation, ongoing diagnosis and remediation, and continuous evaluation.

General Information of Interest to Parents

Mathematical concepts and skills have not changed over the years. What has changed is our understanding and knowledge of how children learn. Consequently, our approach to teaching has changed.

One characteristic of elementary school children is their tendency to be active. Because of this, teaching methods used involve children actively in learning experiences using objects and materials from their environment. For example, before memorizing that $2 + 3 = 5$, children should have many different experiences handling two objects and three objects and putting them together to make five objects. The next step will be to use pictures of objects rather than the objects themselves. Finally they should be able to recall and symbolize the mathematical statement $2 + 3 = 5$.

These concrete (real) objects and their pictorial representations create a better understanding of mathematical concepts and should be used at all grade levels where appropriate or necessary.

Another characteristic of elementary school children is that they are naturally curious. Parents, using everyday home situations, can build on this. Such situations provide an excellent means of establishing relevant and meaningful communication with the child. This would include listening to, questioning, challenging, talking, exploring, playing and learning with the child. It is suggested that parents avoid doing all the talking and providing answers all the time. It is sometimes better to answer a child's question with another question.

It is suggested that parents avoid holding up other children as learning models. Each child has a different learning and maturation rate and, because of this, some children take longer than others to learn some concepts and to develop certain skills.

Parents can play an important role in developing the child's positive self-image. Do not pressure the child. Be patient, encouraging, helpful and give praise where appropriate.

Language plays an important role in mathematics. When talking with the child, use his or her words when discussing or exploring situations. Increase the child's vocabulary by using everyday situations to make relevant such words as tall — short, big — small, wide — narrow, under — over, first — last, before — after, between — behind, etc.

As the child progresses through the elementary grades, he or she will be using more sophisticated mathematical terms. These may not be immediately familiar to parents, but by encouraging the child to explain what these terms mean and to talk about the mathematics he or she is learning, parents will be contributing to the development of a positive attitude towards mathematics.

It is suggested that parents avoid transmitting to the child any negative feelings towards mathematics that parents may have experienced in their own schooling as this will not contribute to the fostering of the necessary positive attitude.

Home and school working together while being mutually supportive of each other can be a most effective force in producing and maintaining the best possible mathematics for children.

Specific Information for Parents

1. The language of mathematics will be developed starting with the language of the child. There will be less emphasis on rote memorization of mathematical terminology.
2. Specific goals have been suggested for each grade level to serve as guidelines. Not every child will necessarily reach these goals at the same time. The goals involve the achievement of mastery and proficiency in various concepts and processes in stages until total mastery and proficiency is attained.
3. There will be varied groupings of children based on the differing rates of learning and maturation. These will provide for more effective teaching and learning. These groupings will not be permanent, but will change throughout the year.
4. The emphasis on understanding will result in a delayed approach to written work in grade 1. In all grade levels the amount of written work may be decreased. (If you have questions, please contact your school.)
5. Parents may from time to time be requested to assist with collections of concrete materials (real objects) and pictures which will be used in the classroom to make learning experiences more meaningful.

General Goal of Mathematics

The aim of elementary mathematics is to foster maximum and continuous development of each child's potentialities in terms of three areas of behavioural growth: the cognitive (factual), the affective (feelings, perceptions), and the psychomotor (movements).

Growth in these behaviours, which will help the child relate to his/her physical and social environment, will result from his/her using mathematical content to develop such processes as:

1. The process of communicating — using mathematical language and symbolism.
2. The process of recall — a means of developing cognitive (factual) skills.
3. The process of conceptualizing mathematical principles.
4. The process of seeing relationships in mathematics.
5. The process of generalizing — finding common elements among mathematical concepts.
6. The process of making applications — applying generalizations to new situations.
7. The process of self-direction — searching for mathematical ideas.
8. The process of discovery — recognizing mathematical ideas.
9. The process of creativity — generating mathematical ideas.
10. The process of appreciating the place of mathematics and its widespread applications in our daily activities.
11. The process of problem solving — identifying, hypothesizing, interpreting, relating, evaluating, concluding.

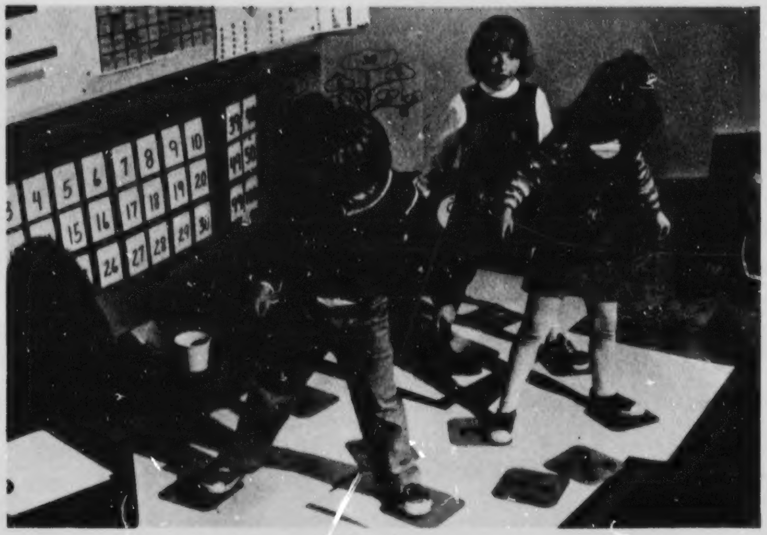
Mathematical content study will promote growth in these processes which in turn will promote growth in the three behavioural areas.

The elementary program has been designed to develop within each student an inquiring mind and to aid each student in developing understandings, skills, abilities, attitudes, values, and appreciations which will enable him/her to think and act effectively, and, become a contributing member of society.

The elementary program has been planned to be a balanced program which will enable the learner to gain a growing or expanding understanding and insight into the structure and organization of mathematics and at the same time develop proficiency in mathematical processes and operations.

The elementary mathematics program has been developed in a natural or sequential order, so that students can develop their understanding of the concepts to a degree of mastery dependent on his/her ability, maturity, and other factors. It incorporates a spiral approach to the four strands: number, measurement, geometry, and graphing, with emphasis on developing logical thinking skills.

The program stresses a wealth of manipulative experiences through which concepts and relations are understood at an intuitive level. However, this intuitive understanding is not sufficient. The student must be able to perform or "do mathematics", or develop increasing knowledge and proficiency of the basic facts and computation skills and processes. This leads to developing the ability to solve problems. The problems should be meaningful appli-



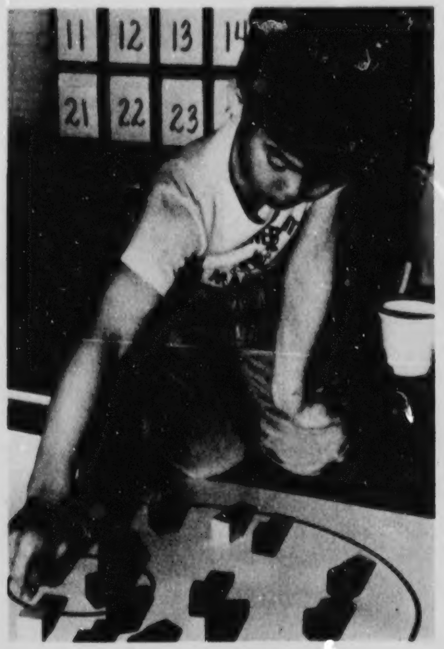
Numbers

cations from the real world, and the solutions should be related back to the real world where they become meaningful. For development of more complete understanding, new topics, concepts, or processes should be introduced or presented with real problems from the real world and illustrated whenever practical with concrete material.

Core Objectives — Kindergarten

As a result of the program, the student should be able to:

1. In informal activities sort objects into sets:
   - a. according to colour
   - b. according to size
   - c. according to shape
   - d. for other reasons
2. Compare two objects and show the difference or similarity:
   - a. size
   - b. colour
   - c. texture
   - d. mass
   - e. bigger than
   - f. smaller than
   - g. other
3. In formal activities sort objects according to:
   - a. one specific attribute
   - b. two attributes
4. Compare two sets of objects to determine which has more, less, as many as.
5. Reproduce a set that has as many objects as, more objects than, less or fewer objects than the given set.
6. Find equivalent sets or select from many sets those sets that have as many things as a given set by matching.
7. Reproduce a given pattern concretely.
8. Continue a given pattern concretely.
9. Create a pattern concretely or pictorially.
10. Arrange a set of objects in order by size or by length.
11. Associate specific events with appropriate parts of the day.
12. Sequence events as they occur during the day.
13. Begin to get ready for the study of divisions of the year.
14. Begin to get ready for the concepts of yesterday and today.



Sets

Core Objectives — Grade 1

As a result of the program, the student should be able to:

1. Compare two objects or two sets of objects re colour, size, etc. Using objects and then pictures develop knowledge of: same, different, larger, bigger, smaller, longer, taller, shorter, wider, narrower.
2. Use and understand vocabulary of position. Using objects and then pictures develop knowledge of such terms as: above, below, over, under, before, after, first, last, between, behind, in front of.
3. Compare more than two objects or two or more sets of objects using such terms as: as many as, more than, fewer than, less than, etc.
4. Count at least up to 10 and down, and count by twos, threes, fours, and fives.
5. Determine the cardinal number of a set with 0 through 10 members (rational counting).
6. Combine two sets to form a larger set (addition) and remove a subset from a larger set (subtraction).
7. Order sets in increasing or decreasing order.
8. Reproduce sets equivalent to (as many as) given sets or named sets.
9. Relate a set to its numeral (symbol) and number.
10. Order numbers in increasing and decreasing order.
11. Understand the property of zero (empty set), e.g., $5 + 0 = 5$.
12. Solve addition number sentences (join two sets) and recognize that addition is commutative, e.g., $5 + 4 = 4 + 5$.
13. Solve subtraction number sentences (remove subsets) or find the difference between two sets.
14. Decide the appropriate operation needed to solve a simple problem.
15. Write numerals (symbols) for numbers 1-9 in sequence after developing and understanding the number concept.
16. Write number sentences to represent number stories.
17. Use numbers 0-10 and develop the number stories for each and learn to use vertical notation for addition and subtraction.
18. Learn to use and understand the symbols +, —, and =.
19. Understand the relation between addition and subtraction as inverse operations.
20. Begin to recall the basic facts for addition and subtraction.
21. Reproduce, continue, and create concrete, pictorial, or action patterns.
22. After having many concrete number experiences and after talking about them, proceed slowly with written work using abstract mathematical symbols.
23. Begin to develop the concept of multiplication and division through concrete experiences.
24. Read and write numerals up to 99.
25. Develop an understanding of fraction ideas through activities with concrete materials, e.g., $\frac{1}{2}, \frac{1}{4}$.

Addition Facts of Six

26. Become aware of and be able to compare and classify 3-D solid geometric shapes, e.g., ball, can, box, etc.
27. Become aware of and be able to compare and classify 2-D shapes, e.g., square or rectangle from a box shape, circle from the top of a can, triangle from certain prisms or pyramids.
28. Understand graphs as a means of visually depicting information using concrete graphs, pictographs, 3-D bar graphs.
29. Recognize coins, e.g., 1¢, 5¢, 10¢, 25¢.
30. Name the days of the week, months of the year.
31. Tell time to the hour.
32. Check off the date on a calendar.
33. Use arbitrary units such as hands, blocks, etc., and standard units such as centimetre and metre to measure and compare length.
34. Develop an awareness of area, volume, capacity, and mass through activities.
35. Solve simple problems through experiences with concrete situations.

Core Objectives — Grade 2

As a result of the program, the student should be able to:

1. Count up to 100 and skip-count by twos, fives, tens and later by fours and threes. Use concrete experiences.
2. Understand place value (11-19) and read and write numerals.
3. Study whole numbers 0-20 individually and relate each to previously studied numbers.
4. Rename numbers as addition sentences, e.g., 12 = 10 + 2.
5. Understand and apply the associative property, e.g., (9 + 1) + 2 = 9 + (1 + 2) — use concrete material.
6. Understand and apply the commutative property, e.g., 3 × 2 = 2 × 3 — use concrete material.
7. Understand the property of zero in addition, e.g., 3 + 0 = 3.
8. Read, write, and interpret horizontal and vertical notation.
9. Understand subtraction as the removal of a subset and as the inverse of addition.
10. Compare sets (one-to-one correspondence) and state the relationship in as many ways (number sentences) as possible.
11. Understand the property of zero in subtraction, e.g., 19 — 0 = 19.
12. Improve proficiency (speed and accuracy) with basic addition and subtraction facts.
13. Develop multiplication facts up to 20 by joining equivalent sets, by using arrays, by repeated addition on a number line, and by skip-counting.
14. Understand division as finding the number of equivalent subsets in a given set, as the inverse of multiplication, and as repeated subtraction on a number line.
15. Learn to use and understand the symbols "×" and "÷".
16. Increase proficiency with multiplication and division facts up to 20.
17. Find and identify $\frac{1}{2}$ and $\frac{1}{4}$ of a concrete thing, and $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ of a set, and $\frac{1}{10}$ as it relates to measurement.
18. Identify, reproduce, continue, and/or create concrete, pictorial or action patterns.
19. Understand place value up to two places.
20. Read and write the numerals up to 100.
21. Apply counting by tens to real situations, e.g., 96 pennies as 9 tens and 6 ones.
22. Relate a number to other numbers before and after or < and > (ordering).
23. Express a number in expanded form orally and in writing as having tens and ones.
24. Round off or estimate to the nearest ten.
25. Add a two-digit and a one-digit number without regrouping (column addition).
26. Recognize and classify 3-D shapes.
27. Analyze and classify 3-D shapes by tracing faces, and by counting faces, corners, edges.
28. Estimate in measurement.
29. Measure lengths with arbitrary units and with standard units, e.g., metres and centimetres.
30. Understand and know the relationship between metres and centimetres.
31. Be aware of and begin to develop an understanding of area and volume using non-standard units in covering up and filling up activities.
32. Become aware of capacity through measurement activities using litre and half-litre.
33. Use the kilogram as a unit of measuring mass, e.g., weighing themselves and record or graph the results.
34. Understand such units as morning, noon, afternoon, evening, night and be able to tell time by the hour, half-hour and quarter-hour.
35. Read the Celsius thermometer and discuss weather in relation to comfort temperatures.
36. Recognize Canadian coins and the one dollar bill through involvement in activities and problems involving addition and subtraction up to 99¢.
37. Develop an understanding of concrete graphs, concrete bar graphs, and pictographs through ongoing graphing activities in several subject areas.
38. Develop problem-solving skills through daily experiences in all subject areas. Begin with oral problems and illustrate answers with concrete materials, e.g., on flannelboard, on magnetic board, etc., and progress to expressing the mathematical sentence orally and in writing.
39. Solve written problems after having acquired sufficient reading and oral problem-solving skills.

Core Objectives — Grade 3

As a result of the program, the student should be able to:

1. Read and write, and know the place value of each digit in numerals 0-999.
2. Know the meaning of and be able to use in number sentences such symbols as: +, —, ×, ÷, =, >, <.
3. Round off numbers to the nearest hundred.
4. Read and write Roman numerals to XX.
5. Write a number in expanded form.
6. Increase proficiency with the addition and subtraction facts up to 20 and the multiplication and division facts up to 40.
7. Rename a number in many ways.
8. Add and subtract multiples of 10 and 100, and columns of 3-digit numbers with and without regrouping.

Sets of 4
2×4=
8÷4=
3×4=
12÷4=
7×4=
6×4=
24÷4=

Multiplication and Division

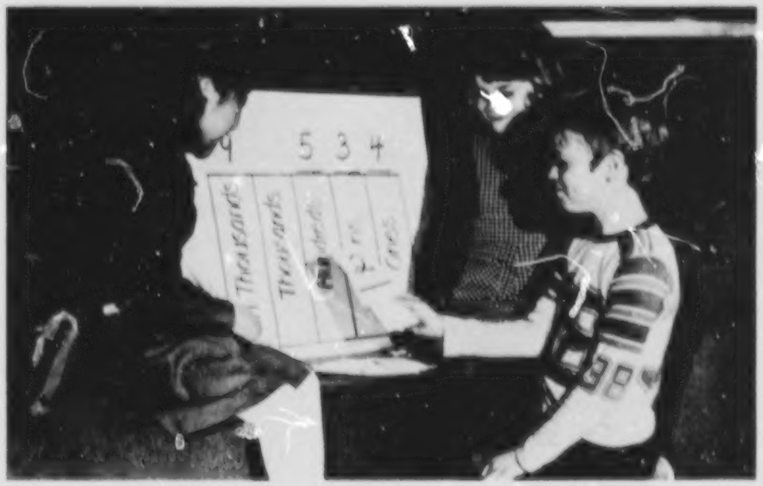
9. Do multiplication and division questions involving 10 and 100 and multiply a 1-digit by a 2-digit number and divide a 2-digit by a 1-digit number.
10. Identify, continue, reproduce, and create patterns using concrete and pictorial materials.
11. Identify fractions as part of a unit or part of a set: $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{1}{10}$ related to metric measure and $\frac{1}{100}$ related to money.

12. Describe 3-D and 2-D shapes in the environment re faces, edges, corners, etc., and sort and classify similar shapes.
13. Locate (not define) and/or illustrate angles, parallel lines, a curved line, or a straight line.
14. Recognize many-sided plane shapes, e.g., stop sign, in the environment.
15. Reproduce a square, a rectangle, and a line segment.
16. Locate lines of symmetry.
17. Estimate and then measure a distance in non-standard and in standard metric units and know the relationships:
    1 m = 100 cm
    1 m = 10 dm
18. Estimate and then find the area of a given 2-D space by covering it up with non-standard or standard 2-D units of area, e.g., cm^2 or m^2.
19. Estimate and then find the volume of a given 3-D space by filling it up with non-standard or standard 3-D units of volume, cm^3.
20. Estimate and measure the capacity of a container in appropriate units: litre, half-litre, millilitre.
21. Estimate and measure the mass of various things using appropriate units, e.g., kilogram, gram.
22. Read the time down to 5-minute intervals and know the divisions of the day, the days of the week, the months of the year, and concepts of yesterday, today, and tomorrow.
23. Read a Celsius thermometer.
24. Solve problems involving addition and subtraction related to money.
25. Construct and interpret graphs using real things, using objects to represent real things, using pictographs, using bar graphs, all involving a one-to-one representation.
26. Interpret and solve a word problem orally and in writing.
27. Apply the concept of estimation (including rounding off) in all problem solving and measurement situations.

Core Objectives — Grade 4

As a result of the program, the student should be able to:

1. Read and write, and know the place value of the digits in up to six-digit numbers.
2. Write numbers in expanded notation.
3. Rename a number in many ways.
4. Round off whole numbers up to six digits.
5. Know the meaning of and be able to use in number sentences such symbols as: +, —, ×, ÷, =, >, <, ≠.
6. Recognize I, V, X, L, C, D, M and read and write numbers up to C.
7. Identify, construct, and continue simple concrete, pictorial, or numerical patterns, e.g., odd numbers, even numbers, factors, primes, composites.
8. Recall with proficiency all basic facts for addition, subtraction, multiplication and division.
9. Relate commutative property, associative property, and property of zero to addition and subtraction as applicable.
10. Add and subtract with and without regrouping with up to three 4-digit addends for addition and subtraction with 4-digit numbers.
11. Round off to tens, hundreds and thousands for estimation.
12. Check addition and subtraction.
13. Apply the commutative property, associative property, distributive property, property of zero, and property of one to multiplication.
14. Multiply whole numbers involving up to a 4-digit factor by a 2-digit factor.
15. Divide up to a 3-digit dividend by a 1-digit divisor, with and without remainder. Lead to the standard algorithm.
16. Determine sets of equivalent fractions.
17. Add fractions having like denominators with sums less than one and sums equal to one.
18. Subtract proper fractions with like denominators and subtract a proper fraction from one.
19. Express 10's and 100's as decimals.
20. Tell time to the nearest minute and use terms a.m. and p.m.
21. Add and subtract units of time with and without regrouping.
22. Read the Celsius thermometer above and below zero.
23. Know relationships among m, dm, cm, km, and measure lengths of objects using appropriate units. Determine perimeter by measuring.



Place Value

24. Find the area of a rectangle (no formula).
25. Determine volume by filling up a container with cubic units (no formula).
26. Determine the capacity of a container using appropriate units (ℓ, ml) and know the relationship between litre and millilitre.
27. Add and subtract capacity measures with and without regrouping.
28. Determine the weight of an object using the appropriate units (kg, g).
29. Recognize and identify 3-D and 2-D shapes in the environment (natural and man-made).
30. Test plane shapes for congruence.
31. Locate axes of symmetry in regular plane shapes.
32. Identify angles as right angles or non-right angles.
33. Illustrate the position of an object (shape) after a slide, flip, or turn.
34. Construct and interpret, involving a one-to-one or a one-to-many representation:
    a. concrete graphs
    b. pictographs
    c. bar graph (horizontal or vertical)
    d. line graph
35. Solve oral and written one-step word problems. Begin developing a procedure for solving all problems.

Core Objectives — Grade 5

As a result of the program, the student should be able to:

1. Read and write base ten whole numbers up to nine digits, including zero as a place holder, and decimals up to three places, and identify the value of any digit in the number.
2. Write whole numbers having up to nine digits and decimals up to three places in expanded form.
3. Round off whole numbers to any of the digits in up to a 9-digit number and decimals to whole, tenths, or hundredths, in order to estimate sums, differences, products, and quotients.

GEOMETRY
STOP
90
1 2 3
11 12 13
10
20
39 40
49 50
99 100

Metric Mass

4. Use appropriate symbols (<, =, ≠, >) to make number sentences true for either equalities or inequalities.
5. Read and write Roman numerals from I to M and translate to Hindu-Arabic numerals and vice versa.
6. Identify, construct, and continue simple concrete, pictorial, or numerical patterns.
7. Identify and illustrate even and odd numbers, factors and multiples, primes and composites, common factors, common multiples, lowest common multiple, and rules of divisibility for 2, 5, and 10.
8. Recall with accuracy and proficiency all basic number facts for addition, subtraction, multiplication, and division.
9. Add and subtract ten and multiples of ten to or from a given number, and multiply and divide a number by ten or multiples of ten orally and in writing.
10. Relate the commutative property, the associative property, the property of zero, and the property of one to the operations of addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals as applicable.
11. Add and subtract with and without regrouping using expanded notation place value grid, and column and horizontal formats for up to four 5-digit numbers or five 4-digit numbers and apply to adding and subtracting money.
12. Begin to use the standard multiplication algorithm to multiply up to four digits by three digits and apply to problems involving money.
13. Begin to use the standard algorithm to divide up to a 6-digit dividend by a 2-digit divisor with and without remainders and apply to money problems.
14. Check the addition, subtraction, multiplication, and division operations.
15. Find the average of a group of three numbers.
16. Illustrate concretely or pictorially the meaning of a fraction, and know the terms numerator, denominator, proper fraction, improper fraction, mixed number, equivalent fraction, and determine a set of equivalent fractions for a named fraction.
17. Reduce a fraction to lowest terms, raise a fraction to higher terms and compare fractions by changing to the same denominator and ordering from smallest to largest or vice versa.
18. Rename an improper fraction as a mixed number or a whole number and vice versa.

19. Add proper fractions with like or unlike denominators, and mixed numbers and proper fractions using either vertical or horizontal format.
20. Subtract proper fractions, proper fractions from mixed numbers with like denominators, a proper fraction or a mixed number from a whole number, a mixed number from a mixed number with like or unlike denominators, but with no regrouping.
21. Express decimals (up to three places) in fractional form in lowest terms and vice versa.
22. Add and subtract decimals involving tenths, hundredths, and thousandths, using either vertical or horizontal notation.
23. Know the pertinent relationships among second, minute, hour, day, week, month, year, decade, and century, record the date in SI format, read the time on a 12-hour clock, a 24-hour clock, a digital clock, and add and subtract units of time.
24. Read the Celsius thermometer above and below zero.
25. Know the relationships among kilomètre, metre, decimetre, centimetre, and millimetre, use the appropriate units to measure linear distances, add and subtract linear measures with and without regrouping, and explore and measure perimeters (no formula).
26. Know the relationships among the common units of area and use the appropriate units to determine or measure the area of various geometric shapes (no formula).
27. Know the relationships among the common units of volume and use the appropriate units to determine or measure the volume of various cubic structures (no formula).
28. Know the relationships among the common units of capacity and use the appropriate units to determine or measure the capacity of various containers (no formula).
29. Know the relationships among the common units of mass or weight and determine or measure the mass of various objects.
30. Describe, illustrate, construct, and label a line segment, and identify open and closed curves.
31. Identify, locate, and construct (not compass and ruler constructions) parallel and perpendicular lines.
32. Test given line segments and shapes for congruency and reproduce line segments and shapes congruent to given line segments and shapes.
33. Compare given angles with right angles and measure angles using an arbitrary angle as the unit of measure.
34. Classify three-, four-, five-, six-, and eight-sided regular polygons according to the number of equal sides and angles.
35. Classify triangles as right angled or non-right angled and construct right triangles using graph paper, geopaper, geoboard, and paper folding.
36. Test shapes for and identify lines of symmetry in nature and in the environment.
37. Identify a motion as a slide, flip, or turn. Construct images of shapes after a slide, flip, or turn, and find examples of slides, flips, or turns in the environment.
38. Construct, interpret, title, and report on a concrete graph, a pictograph, a bar graph, a line graph, and locate points represented by ordered pairs or number pairs in the first quadrant.
39. Solve oral, computational and word problems involving one- and two-steps. Continue to refine the procedure for solving all problems. This may apply to whole numbers, fractions, and decimals.

Part of a Set

Core Objectives — Grade 6

As a result of the program, the student should be able to:

1. Read and write base 10 whole numbers up to ten digits and decimals up to three places.
2. Write numbers in expanded form.
3. Interpret and write numbers (tens) in exponential form when writing numbers in expanded form.
4. Rename numbers in many ways.
5. Round off whole numbers up to ten digits, and decimals up to any one of three places.
6. Write appropriate symbols to make number sentences of equalities and inequalities true.
7. Identify, construct, complete, and create concrete patterns, pictorial patterns, and numerical patterns.
8. Identify and illustrate even and odd numbers, factors, multiples, common factors, greatest common factor (G.C.F.), common multiples, lowest common multiple (L.C.M.), prime numbers and composite numbers from 1-100, and rules of divisibility for 2, 4, 3, 6, 9, 5, and 10.
9. Recall with proficiency (automatic response) all basic number facts for addition, subtraction, multiplication and division.
10. Add and subtract groups of numbers with up to six digits with and without grouping, and in either vertical or horizontal format.
11. Add and subtract money involving up to six digits.
12. Round off to multiples of ten to estimate answers when adding, subtracting, multiplying and dividing.
13. Check addition, subtraction, multiplication and division.
14. Multiply and divide whole numbers using the standard algorithms with up to a combined total of eight digits in multiplication and up to a 6-digit dividend by a 3-digit divisor with and without remainders.
15. Perform multiplication and division operations involving money by converting dollars to cents to avoid decimals.
16. Find the arithmetic mean or average of at least three numbers.
17. Find sets of equivalent fractions, reduce a fraction to lowest terms, raise a fraction to higher terms, compare fractions having like or unlike denominators, order fractions in increasing or decreasing order.
18. Add (up to four addends) and subtract proper fractions or mixed numbers with like or unlike denominators with and without regrouping using the vertical or horizontal format.

Equivalent Fractions

19. Multiply a fraction by a whole number and a mixed number by a whole number and vice versa.
20. Understand and read and write decimals up to three places and rename as fractions in reduced form and vice versa.
21. Express a decimal and a fraction as a percent and rename a percent as a fraction and a decimal.
22. Round off decimals to wholes, tenths, or hundredths.
23. Add and subtract decimals, using the vertical or horizontal format, and involving combinations of tenths, hundredths and thousandths.
24. Multiply a decimal by a whole number and divide with up to a 3-digit decimal divisor by converting to whole numbers.
25. Apply addition, subtraction, multiplication, and division of decimals to one- and two-step problems.
26. Recognize, interpret, and use different ratio formats and recognize a proportion as a comparison of two ratios.
27. Apply the commutative property, associative property, distributive property, the property of zero, and the property of one where applicable to the operations of addition, subtraction, multiplication and division re whole numbers, fractions, and decimals.

1/2
1/2
1/3
1/3
1/3
1/4
1/4
1/4
1/4
1/8
1/8

Fractions

Metric Measure

28. Maintain the pertinent relationships among second, minute, hour, day, week, month, year, decade and century, record the date in SI format and read the time on a 12-hour, 24-hour, and digital clock.
29. Solve money problems involving addition, subtraction, multiplication, and division.
30. Read the Celsius thermometer above and below zero.
31. Know the relationships among kilometre, metre, decimetre, centimetre and millimetre, and use appropriate units to measure linear distances.
32. Using appropriate units, determine the area of various shapes and discover the formula for rectangular shapes ($A = L \times W$).
33. Using appropriate units, determine the volume of various objects and explore the relationship between volume and capacity.
34. Using appropriate units, determine the capacity of a container.
35. Using appropriate units, measure the mass of an object.
36. Be aware of the basic concepts pertaining to 3-D (solid) and 2-D (plane) shapes and identify open and closed curves.
37. Name the parts of an angle, label an angle, measure an angle with a protractor, and classify angles according to their size.
38. Classify triangles, quadrilaterals, and polygons according to the number of equal sides.
39. Determine the number of lines of symmetry in regular polygons.
40. Identify and name the parts of a circle.
41. Test figures for congruence.
42. Identify motions as slides, flips, or turns and indicate the position of a shape following a slide, flip, or turn, and test shapes for congruence after a slide, flip, or turn.
43. Construct, interpret, title, and report on concrete graphs, pictographs, bar graphs, and line graphs, plot number pairs or ordered pairs in the first quadrant, and interpret simple circle graphs.
44. Solve oral, computational and word problems involving one- and two-steps. The procedure should involve the process of estimating the answer, the written analysis (writing the number sentence), using the given information, the solving of the number sentence, and the comparison of the estimated and the computed answer, and the checking of the computed answer.

NOTES ON PROGRAM IMPLEMENTATION

NOTES ON PROGRAM IMPLEMENTATION

A. *Rationale*

This curriculum guide reflects a change in emphasis from that of the previous one and places stress on a balance between an understanding of the structure and language of mathematics, and sound skill development.

In some cases, the heavy emphasis previously placed on vocabulary and the resulting de-emphasis of skills has resulted in the replacement of memorization of number facts with memorization of mathematical language. Such language should be used in the classroom, but children should not be expected to memorize the terms.

This guide has taken into consideration the developmental stages of learning Piaget, as well as Skinner's operant conditioning in its stress on maintenance of computational development coupled with understanding.

Piaget perceives the learner as a "doer", acting upon objects and experiences to acquire knowledge and skills, and communicating with others to develop a critical, exploring mind.

The stress on activity-oriented approaches using concrete manipulative materials to aid in the discovery, understanding, and development of a concept must be followed up by a solid program of reinforcement in order that the fundamental concepts and skills are understood.

Answers?

There is a definite place for drill in skill development after a concept is understood. In no way should "drill" replace sound teaching and learning activities, but it should be recognized as part of the learning process. Practice for skill development can take varied forms such as games, puzzles, contests or flashcards, and should not be restricted to dull, repetitive seat work.

Geometry in the elementary grades is approached in this outline from its existence in the real world environment of the children. Thus the approach is first through solids (three-dimensional objects). From the solids, the two-dimensional shapes are observed and their relationship discovered.

The committee in developing this revised outline has paid close attention to the recommendations of the *Report of the Council for the Development of School Mathematics Curricula K-12 in Manitoba, 1972,* which was published by the Department of Education.

B. *Specific Objectives of the Mathematics Program*

1. To provide experiences which will lead to increased understanding, knowledge and skills in numbers and operations appropriate to the needs and capabilities of children.
2. To develop an understanding of the structure of the number system and its applications.
3. To develop an understanding and mastery of the skills of computation.
4. To develop an understanding and facility with measurement including estimating, approximating, and verifying through use of appropriate measuring instruments. These concepts are important mathematical tools.
5. To teach children to observe, identify and be aware of geometrical relationships involving space and shape.
6. To diagnose weaknesses on an ongoing basis and provide appropriate remediation related to practical, everyday situations.
7. To provide opportunities to increase understanding of problem solving, critical thinking, and methods of inquiry and discovery in mathematics.
8. To encourage children to observe, collect, interpret and display data in simple graphs as a part of their communication skills.

C. *Integration*

Teachers are encouraged to be aware of ways of integrating or correlating mathematics with other subjects. The arbitrary division of learning into subject areas is artificial and not always necessary for most effective learning. Some learning can be made more *productive* by dealing with a theme out of which can develop language skills, science, social studies, art, mathematics, etc. However, in order that mathematics not be relegated to a low priority in the integrated classroom, teachers should be aware that mathematics must remain an identifiable part of the school program in order that all concerned (children, parents, administration, etc.) can appreciate where, when, and how much mathematics is learned.

D. *Diagnosis and Evaluation*

The purpose of *diagnosis* is to identify strengths as well as weaknesses. In the case of diagnosing weaknesses, the purpose is to identify the cause and provide *appropriate remediation* for individuals or groups of children.

The written test for one concept, or for several concepts, is the most commonly used tool for diagnosis. However, there are others which are very effective, particularly in the primary grades.

1. Individual interview techniques:
   Diagnose as you discuss with students and listen to the students as they orally progress through a mathematical question or problem. These techniques can be used for evaluation purposes as well.
2. Skillful questioning and observing:
   Observe and analyze how the students work, and devise ways of helping them to do their work better.

In all cases, the emphasis is not only on ascertaining what each child knows, but also how he or she thinks when using mathematical procedures and if necessary, providing specific remedial help.

E. *Estimation*

There is general agreement that developing skill in estimation should be a major objective of the school mathematics curriculum K-12. Estimation is a fundamental skill that every student needs to develop. Its purpose is to provide a quick check on the reasonableness of answers in computation and problem solving. Estimation is a *mental process* — not a pencil and paper procedure.

Estimation is sometimes a difficult process for some students. One hypothesis as to the cause of the difficulty is that students *lack the prerequisite skills* required for the various estimation strategies, viz.,

1. the ability to round numbers;
2. proficiency in operating with multiples of 10, 100, 1000, etc.;
3. facility with mental arithmetic.

Estimation encompasses a variety of mathematical skills that are used daily in one form or another. These skills require a genuine understanding of basic mathematical concepts and take years to learn. Estimation needs to be taught and stressed in all grades. Consequently, the responsibility for developing estimation skills must be shared among all teachers at the elementary and secondary level.

Estimation is also an important aspect of measurement. It can be applied to a variety of counting problems, e.g., the number of people at a ball game or the number of beans in a jar.

Points of Emphasis Re Teaching of Estimation

1. Estimation should not appear as an isolated topic but should be integrated into the curriculum and applied whenever possible. It can be introduced in primary grades in simple addition and subtraction problems.
2. Students must be convinced that estimation should be used to save time and energy when precise calculations are not necessary. Estimation is approximation.

F. *Mental Arithmetic*

Oral-mental arithmetic is extremely important. A few minutes of well-motivated oral practice daily will pay off in achievement. Too often, pupils become almost entirely dependent upon "thinking with their pencils".

Well-conducted mental arithmetic practices are a means of providing drill for students and helping them to maintain mastery of basic facts. Mental arithmetic may be practiced using questions on the chalkboard, on the overhead, or in a handout, or asking questions orally. This type of practice will motivate students to improve their speed and accuracy with arithmetic operations, as well as help them gain a feeling of confidence in dealing with numbers.

G. *Patterns*

Patterns are everywhere. Besides being an underlying theme of mathematics, they are in nature, in music, in art, in our environment, etc. As well, they can be integrated with other subject areas through visual, auditory and physical activities. These experiences can stimulate curiosity and creativity in children and at the same time help to develop their ability to anticipate and predict. Possessing this ability means that one can anticipate a step in a process without having to experience all the preceding steps — a very useful tool for everyday living.

The study of patterns by children can affect their development of mathematical understanding, and can encourage analytic thought and decoding. *Patterns provide insight into the structure of the number and numeration systems and are a powerful tool in simplifying the process of problem solving.* Their study can be a preparation for the concepts of infinity, equivalent fractions, motion geometry, tessellations, etc.

H. *Changing Role of Decimals and Fractions*

Much controversy and misinformation abounds regarding the role of decimals and fractions in light of the implementation of the metric system into the school curricula.

Fractions will remain as a fundamental part of the school math program, with some change of emphasis. *Decimals will take on a stronger role*, particularly with regard to measurement. Operations with complicated uncommon fractions will be de-emphasized, but understanding and skills in basic operations with fractions will remain important. Understanding of and facility with equivalent fractions should be stressed before proceeding with the operations with fractions.

This curriculum guide suggests that one-place decimals be introduced in grade 2 to correspond with metric measurement in centimetres, etc., and two-place decimals in grade 3 to correspond with money measurement (dollars and cents).

At the grade 2 level there can be a simple introduction of the notation 0.1 to represent $\frac{1}{10}$, 0.2 for $\frac{2}{10}$ . . . 0.9 for $\frac{9}{10}$ . . .

Simple operations with one-place decimal notation could be done at the grade 3 level.

e.g.,
$$\begin{array}{r} \frac{1}{10} \\ +\ \frac{3}{10} \\ \hline \frac{4}{10} \end{array} \quad \text{OR} \quad \begin{array}{r} 0.1 \\ +\ 0.3 \\ \hline 0.4 \end{array}$$

Children will be able to solve the above using the same procedure as for
$$\begin{array}{r} 1 \\ +\ 3 \\ \hline 4 \end{array}$$

At the grades 5 and 6 level, addition and subtraction of fractions should be understood and mastered, but multiplication should be introduced without the expectations of mastery until the grade 7 level. (The revised junior high mathematics curriculum guide has taken this into account.)

The decimal concept and the four basic operations with decimals are all introduced and should be reasonably well mastered by the end of grade 6. These operations usually provide less difficulty than operations with fractions.

NOTE: The above comments refer to average and above-average students. It is recognized that these may not be reasonable expectations for all students, and teachers should consider this in their individualized program planning.

Graphing Heights

I. *Graphing*

Graphing is gradually developed through the elementary grades in the following order:

1. concrete graphs;
2. pictographs;
3. bar graphs;
4. line graphs.

Teachers are cautioned to ensure that line graphs are used correctly.

Line graphs are used to illustrate related (continuous) data, e.g., height OR weight of one particular child *over a period of time*, whereas, *bar graphs* are used to illustrate non-related, non-continuous (discrete) data, e.g., heights OR weights of all the children in a class *at a particular time*.

It should be noted that graphing situations can be best initiated in other subject areas such as science and social studies.

Classifying Shapes

J. *Geometry*

A major and fundamental change of approach to geometry is recommended in this curriculum guide.

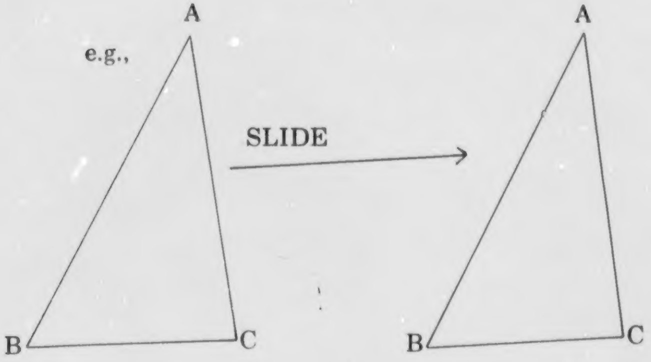
In the elementary grades, geometry should be introduced informally through activities which create awareness of three-dimensional (3-D) objects in our environment. Children should note the shape, size, thickness, as well as colour and texture of these objects. Classification activities can be initiated in order that children learn to sort, compare and classify according to geometric properties. Activities involving cubes, cuboids, prisms, spheres, cylinders, cones, and pyramids should become a part of every child's experience. Counting corners, edges, and faces of these solid objects are fundamental activities.

Out of the study of 3-D (solid) objects grows the awareness, identification and classification of 2-D (plane) shapes such as circles, squares, rectangles, and triangles.

Symmetry should be thoroughly explored and can provide a basis for comparison of both solid and plane shapes. The existence of lines of symmetry can be explored using tracing paper, paper folding, and/or a semi-transparent plastic mirror (trade name MIRA, available from Moyers, MIRA Math Company, or Edu-Media).

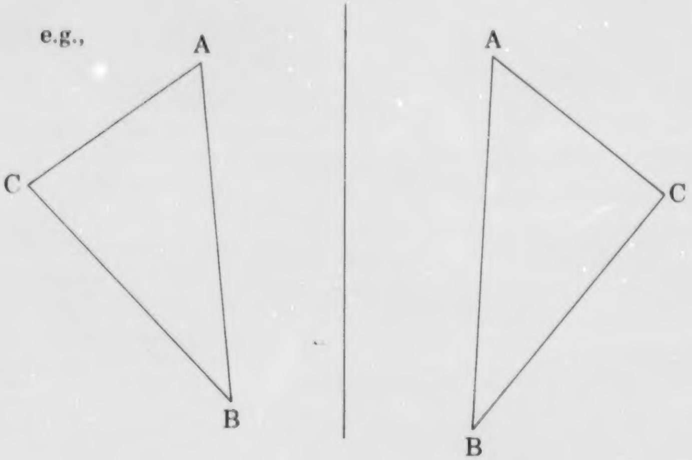
In order to discover and develop fully the concepts of symmetry, shape, and congruence, an approach referred to as "motion geometry" or "transformation geometry" is recommended. This approach is based on three simple operations as illustrated below:

1. *Slide:* A simple change of position in any direction. This can be easily accomplished with the use of tracing paper.



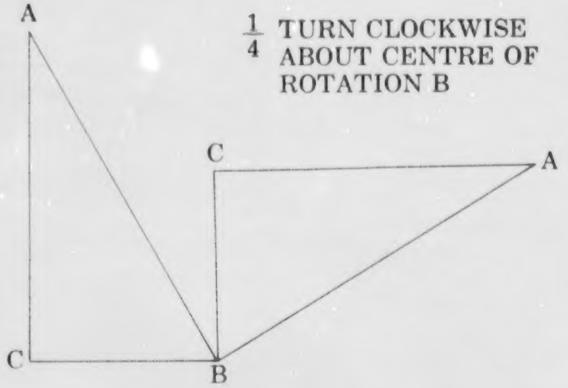
2. *Flip* (reflection): A change of position accomplished by "flipping" an object over a line (mirror line) or by reflecting in a mirror or MIRA, or by paper folding and tracing. The mirror line (line of symmetry) is known as an *axis of reflection.*

e.g.,

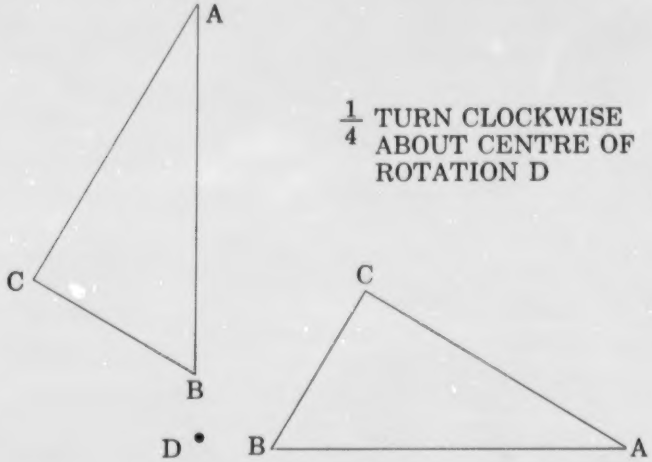


3. *Turn* (rotation): This change of position is accomplished by turning an object or shape about a fixed point (called centre of rotation). Tracing paper, a sharp pencil or a compass are useful aids.

e.g.,


A
$\frac{1}{4}$ TURN CLOCKWISE
ABOUT CENTRE OF
ROTATION B
C
A
C
B

This fixed point could be on the shape as in previous diagram or outside the shape as in the example below:


A
$\frac{1}{4}$ TURN CLOCKWISE
ABOUT CENTRE OF
ROTATION D
C
C
B
D
B
A

Children learn to understand and appreciate geometry more readily if it is related to their own experience and to the real world. For this reason, solid and motion geometry are considered fundamental to an elementary school math program. Motion geometry allows children to perform activities in which they can readily see things happening to real objects.

Practical Problems

K. *Problem Solving*

1. *General Discussion*

The term "problem solving" should be interpreted in a broad sense. That is, we do not only consider word problems in the texts, but also classroom situations which require a solution, such as finalizing UNICEF collections, handling and totalling money for class photographs, or keeping records of physical fitness activities. Some problems do not necessarily require a number sentence as a means to a solution; many situations can be clarified by graphs or pictures, especially in early primary grades.

Daily oral and/or written problem-solving activities should be an integral part of the mathematics program. Such activities make the mathematics class more interesting and the content more relevant, and can give the teacher an insight into the development of the child's reasoning ability and computational skills.

Many real mathematics problems are encountered in science, social studies, art, and other activities, both in and out of school.

An important factor which could contribute greatly to proficiency in this area is the development of a positive attitude toward problem solving. This attitude may gradually develop as the children gain confidence in their skills, know the basic facts, and learn to use measuring instruments, estimate quickly and communicate mathematically. Although this positive attitude cannot be taught, the teachers can play an important role in its development by encouraging discussion, initiating enjoyable activities using a variety of materials, and accepting a diversity of approaches to the solution of the problem.

2. *Stages of Thinking — Levels of Conceptualization Applied to Problem Solving*

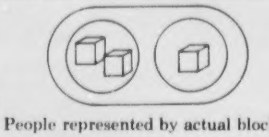
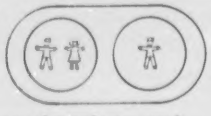
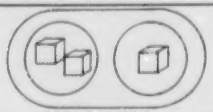
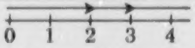
The stages of thinking listed in the chart at the right are generally accepted as the series of stages through which students progress as they grow and develop in their problem-solving proficiency.

There is a variation in the ages and grade levels at which students move from stage to stage and also in the amount of time required for students to fully develop in each stage. Most students do not work or think in one stage only, e.g., abstract. They do, however, quickly (possibly in their own minds or in some cases by actual diagramming of problem solutions) go through several stages as they proceed to solve a problem.

The ultimate success of any concept or curriculum depends on the degree of involvement of the participants (students and teachers). This success will be most effectively achieved if the involvement is at the level or levels of thinking or conceptualization at which the students can think and work with ease and proficiency.

Problem: Two boys are standing at the front of the classroom. Another boy goes from his desk to the front of the classroom. How many boys are now at the front of the classroom?

A problem is perceived.

STAGES OF THINKING	TEACHING METHODS	LEVELS OF CONCEPTUALIZATION
Concrete	Real objects are manipulated to arrive at solutions.	The problem is acted out using real people
Concrete	Nonrepresentational concrete objects are manipulated to arrive at solutions.	 People represented by actual blocks
Semi-Concrete	Pictures of real objects are used in arriving at solutions.	 Pictures of people are used
Semi-Concrete	Drawings of nonrepresentational objects are used in arriving at solutions.	 Pictures of blocks which represent people are used
Semi-Abstract	A graphical model is constructed.	 A graphical model is used
Abstract	A mathematical model is constructed to represent the structure of the relationship.	$2 + 1 = \square$ $2 + 1 = n$ Number sentence is written
Abstract	Algorithms and mathematical processes are applied.	Problem solved by addition $\begin{array}{r}2\\+1\\\hline 3\end{array}$
Abstract	A generalized mathematical model is developed for future use.	$a + b = \square$ $a + b = n$ Generalized statement is written

3. *Suggested Steps in Problem Solving*

Developing an awareness of certain problem-solving procedures will help the children build skills and gain knowledge which will enable them to find solutions. The following are suggested steps in problem solving:

1. *Understanding the problem*
   - — visualize: represent situation concretely, pictorially or mentally
   - — discuss vocabulary
   - — interpret — what is known?
     - — what is the question to be answered?
     - — what is not known?

2. *Deciding on procedure (make a plan)*
   - — how will the answer be found?

3. *Carry out plan*
   - — estimate where feasible (round off)
   - — measure, if applicable
   - — write open number sentence
   - — solve number sentence

4. *Check solution*
   - — does it answer the question?
   - — is the answer reasonable (compared with estimate)?
   - — is the solution accurate?

5. *Conclusion*
   - — discuss solution
   - — possible different number sentences

L. *Role of Concrete Materials and Activities*

It is most important that the learning process consist of active involvement of children using concrete manipulative materials which have intrinsic interest for the age group. Learning occurs as the students travel the continuum from concrete to semi-concrete to abstract thinking.

Mathematical symbols are abstract and should not be introduced until the children have many number experiences and can talk about them with understanding. When children can think about numbers without needing the actual objects to assist them, they are ready to record their thinking using written symbols.

The use of concrete materials and activities should be an integral part of all learning and not restricted to the primary grades nor for remedial work. All children should have experience with these materials and activities.

A wide variety of manipulative materials should be provided, ranging from teacher-made and student-made to commercially available aids. Those made by the students themselves are often the most widely used and most meaningful. The following list, though by no means complete, may be useful:

1. flannelboard and materials
2. Cuisenaire rods
3. pegboard and pegs, geoboards and elastic bands
4. assorted beads, parquetry blocks
5. counters in individual containers for pupils — plastic counters, beads, buttons, peas, beans, acorn cups, bottle tops, blocks, pegs, pill vial containing plastic bread tags, etc.
6. numeral and symbol cards
7. number tickets
8. number line
9. bundles of ten — coffee stirrers, straws
10. magnetic board and material
11. bean bags
12. skipping ropes and hula hoops
13. building and counting blocks — large, small, coloured
14. cardboard clock face or real clock, plastic lids for clock faces
15. cartons, cans, boxes, bags for play store
16. toy money — real money
17. counting frames
18. demonstration cardboard cut-outs — squares, circles, rectangles, triangles, stars, etc.
19. dominoes
20. egg cartons
21. flashcards — pictorial, domino design, number cards
22. duplicating devices

23. litre and millilitre containers
24. plastic cup and other non-standard units
25. number readiness charts
26. old catalogues and fliers
27. metre stick — in various calibrations as necessary for grades and levels
28. rulers (20 cm preferred) in various calibrations as necessary for grades and levels
29. spring balance, balance scale, compression scale
30. MIRA, mirrors, mirror cards, tracing paper
31. string, tape, metric tape
32. Celsius thermometer
33. Unifix cubes
34. geometric solids — straws, pipe cleaners, to construct models
35. Dienes blocks
36. attribute blocks — Logi blocks
37. sets of square metric units to measure area
38. sets of cubic metric units to measure volume, e.g., centicubes
39. abacus
40. 100 chart

In addition, interesting reinforcement of many mathematical skills and concepts may be provided by the following games:

1. "The Winning Touch"
2. "Tuf"
3. "Krypto"
4. "Concentration"
5. "Battleship"
6. "Fraction"
7. "Dominoes"
8. "Heads Up"
9. "Snakes and Ladders"
10. "Multo"
11. "Number Tutors"

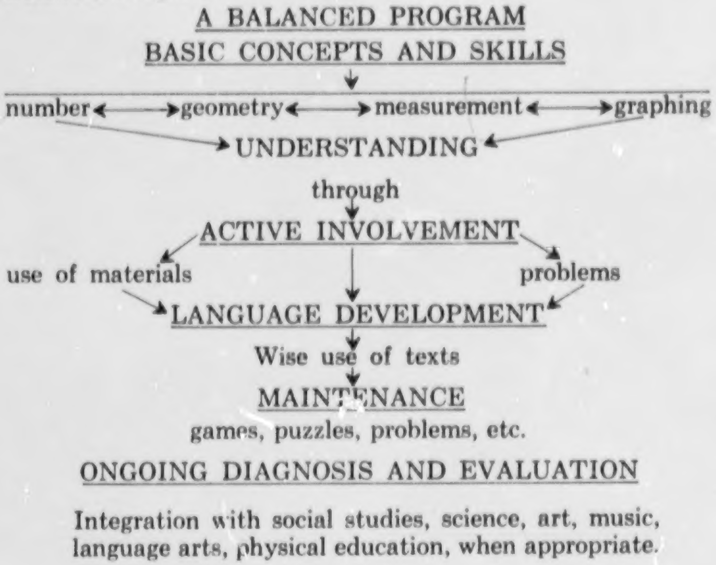
M. *Role of Textbooks and Workbooks Within the Program*

This curriculum guide is the core of the elementary mathematics program and, as such, can supply the classroom teacher with the basic skills and concepts for any particular grade level. It has been set up independent of any textbook series and therefore allows for greater flexibility in scope and approach than may be advocated in a particular textbook.

To date, several textbook series (SI metric) have been approved. More than one series could be used in a particular grade level. Teachers should have access to the teacher's guides of all these books for resource purposes so that they can select relevant exercises, activities, and games to introduce and reinforce the basic concepts. They should also feel free to change or delete pages or sections which are too difficult or not relevant. *A workbook is for practice and consolidation, not for teaching.* It should be noted that in the primary program the extent of number study does not go as far as suggested in most textbooks and workbooks. It is felt that a more thorough study of smaller numbers gives the children a better basis for further study of larger numbers.

As stated previously, teachers are encouraged to plan their own program. *The curriculum guide and no one textbook should be used as the basis for this planning.*

N. *Balanced Program*


A BALANCED PROGRAM
BASIC CONCEPTS AND SKILLS
number
geometry
measurement
graphing
UNDERSTANDING
through
ACTIVE INVOLVEMENT
use of materials
problems
LANGUAGE DEVELOPMENT
Wise use of texts
MAINTENANCE
games, puzzles, problems, etc.
ONGOING DIAGNOSIS AND EVALUATION
Integration with social studies, science, art, music, language arts, physical education, when appropriate.

O. *Organizing Your Mathematics Program: Time Allotment*

The purpose of the guide is firstly to identify for teachers the goals and objectives of a mathematics program and secondly to provide practical assistance for the performance of their task as they work with children to achieve these objectives.

Although this curriculum guide gives an outline of concepts, skills, and objectives, teachers are encouraged to plan their own course organization. It is not advisable to follow through this outline topic by topic, but rather to integrate, e.g., number work, decimals, measurement, graphing, problem solving, etc., in a spiral approach. Children learn and retain knowledge and skills through exposure and re-exposure at advancing levels of complexity.

The primary intent of the program is to have children achieve as many of the objectives as they are capable of achieving. Variations in age and abilities make it impossible for all children to learn the same amount or at the same rate. Thus, grouping of children for instruction and activities is necessary. These groups may vary regularly, depending upon the topic and activities. Grouping can include small working groups, teaching groups or whole class groups.

Based on experience, it is recommended that, on an average, a minimum of 45 minutes per day be allotted to the teaching of the mathematics program although as indicated earlier the needs of the particular children involved may require that varying amounts of time be spent to achieve the objectives. At the grades 1 and 2 level it may be advisable to divide the time into two shorter periods, in keeping with the attention span of the students.

The report of the Mathematics Council, in dealing with the concept of continuous progress and the frequent abuses related to it, offers the following statement: "Continuous progress . . . must fit both the individual's development and his ability. One must distinguish between continuous progress and that which must be done at times to help it occur, such as individualization of instruction, contract system, or non-grading."

Measurement

SCOPE AND SEQUENCE
FOR
CONCEPTS AND SKILLS
K-6

INTRODUCTORY NOTES

1. *Language Development* —

   The teacher should use language the child understands. Correct mathematical language and terminology can be introduced gradually by the teacher, but should not be stressed. Definitions, including applicable field properties, need not be memorized.

2. *Basic Facts* —

   The basic facts for addition and subtraction are developed in grade 1, and followed in later grades with those for multiplication and division. The development of mastery of and proficiency with these facts should begin in grade 1 and progress gradually with complete mastery and proficiency to be achieved as soon as the student is able, or at least by the end of grade 4.

3. *Estimation* —

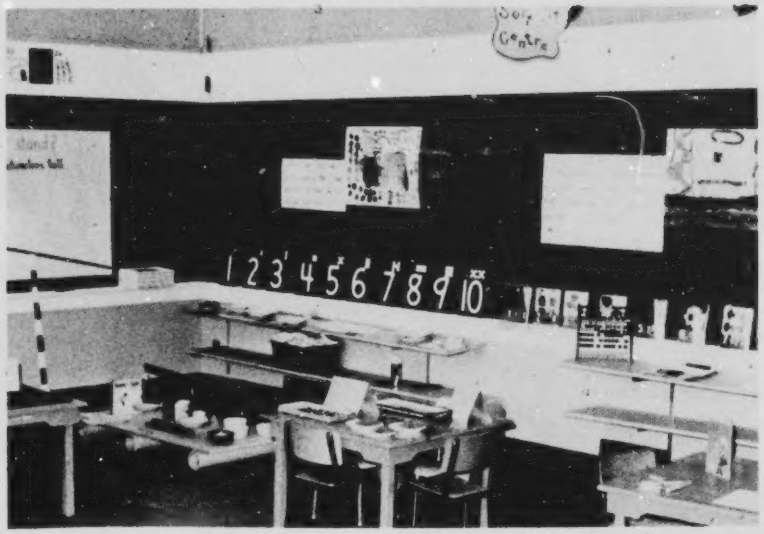
   The process of estimation should begin early and should be practiced by all students whenever feasible, e.g., in problem-solving situations, especially oral problems.

4. *Problem Solving* —

   The development of problem-solving skills should begin in grade 1 with concrete experiences and oral interpretation of the problem. The process should develop on a regular (daily) basis and progress from the oral to written one-step problems and later (grade 5) to two-step problems.

5. *Maintenance* —

   Regular attention should be given to maintaining mastery and proficiency of all facts, operations, and processes. This will be done by means of a regular drill program using a variety of methods including emphasis on oral-mental mathematics.



Concrete Materials

KINDERGARTEN

The basic approach in the kindergarten program is one of involvement in activities which should be informal, integrated, and take into account the child's innate curiosity and stages of child growth.

The kindergarten program is basic readiness for all aspects of mathematics, however, formal number work is not introduced at this level.

The kindergarten program includes the following topics:

— sorting and comparing objects and sets of objects
— reproducing sets involving as many as, more than, less than
— reproducing, continuing, and creating patterns
— ordering by size, by length
— time — *some aspects of the division of the day and the year* and the concept of yesterday and today (these activities are continued into grade 1)

COUNTING NUMBERS

CONCEPT/ OPERATION	1	2	3	4	5	6
Counting	— rote counting at least up to 10 — enumerating or rational counting to find how many objects in a set	— count up to 100 M	— count up to 999 M	M M	M M	M M
Skip-counting	— by 2's and later by 3's, 4's and 5's	— by 2's, 3's, 4's, 5's and 10's	— count up to 100 and beyond by 2's, 3's, 4's, 5's, and 10's	M	M	M

M = MAINTAIN AND DEVELOP

WHOLE NUMBERS

CONCEPT/ OPERATION	1	2	3	4	5	6
Written work	— form the numerals correctly	M	M	M	M	M
Place value	— readiness	— 10 to 20 — up to 100 — how many tens and ones in numbers up to 99	— up to 999 — how many 100's, 10's, and 1's in numbers up to 999 — write numbers in expanded format	— up to 6 digits M	— up to 9 digits including zero as a place holder M	— up to 10 digits including zero as a place holder M
Read and write numerals in sequence	— from 0 to 10	— up to 100	— up to 999	— up to 6 digits	— up to 9 digits and decimals up to three places	— up to 10 digits and decimals up to three places
Order numbers	— 0 to 10	— from 0 to 100	— from 0 to 999	— up to 6 digits	— up to 9 digits	— up to 10 digits
Find the number before or after a given number	— from 0 to 10	— from 0 to 100	— from 0 to 999	— up to 6 digits	— up to 9 digits	— up to 10 digits
Find a number between two given numbers	— from 0 to 10	— from 0 to 99	— from 0 to 999	M	M	M
Give the value of any digit in a numeral	— readiness	— up to 2 places	— up to 3 places	— up to 6 places	— up to 9 places	— up to 10 places

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WHOLE NUMBERS — OPERATIONS

CONCEPT/ OPERATION	1	2	3	4	5	6
Addition	— combining sets	M	M	M	M	M
	— developing mastery of basic facts	M	M	— proficiency with all basic addition facts	M	M
	— combining with empty set	M	M	M	M	M
	— oral number sentence — written number sentence	M	M	M	M	M
	— vertical notation	M — horizontal notation	M	M	M	M
	— add two 1-digit addends	— add two 2-digit addends	— 2-digit column addition with two addends	— column addition with up to three 4-digit numbers	— column addition with up to five 4-digit or four 5-digit addends	— up to 6-digit numbers
		— no regrouping	— no regrouping — with regrouping	— no regrouping — with regrouping	— no regrouping — with regrouping	— no regrouping — with regrouping
			— estimating sums (rounding off)	M	M	M
			— add multiples of 10 and 100	M	M	M
			— addition with money	— addition with money	M	M
				— checking addition	M	M
				— one-step word problems	— one- and two-step word problems	M

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WHOLE NUMBERS — OPERATIONS

CONCEPT/ OPERATION	1	2	3	4	5	6
Subtraction	— remove a subset	M				
	— difference between sets	M				
	— inverse of addition	M				
	— developing mastery of basic facts	— developing mastery of basic facts up to 20	— developing mastery of basic facts up to 20	— proficiency with all basic subtraction facts	M	M
			— with multiples of 10 and 100	— with 10 and multiples of 10	M	M
	— oral number sentence — written number sentence — missing addend	M	M	M	M	M
	— vertical notation — horizontal notation	M	M	M	M	M
	— identify empty set					
		— column subtraction up to two 2-digit numbers — no regrouping	— column subtraction up to two 3-digit numbers — no regrouping — with regrouping — with 2 regroupings — with zeros	— column subtraction up to 4-digit numbers M — expanded notation — place value grid	— up to 6-digit numbers M	— up to 6-digit numbers M
				— subtraction with money	M	M
				— checking subtraction	M	M
				— one-step word problems	— one- and two-step word problems	M
	63		— estimating differences rounding off	M	M	M

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WHOLE NUMBERS — OPERATIONS

CONCEPT/ OPERATION	1	2	3	4	5	6
Multiplication	— readiness	— meaning	— meaning of multiplication			
		— combine equivalent sets — illustrate concretely — illustrate with arrays — illustrate with number line	— combine equivalent sets — illustrate concretely — illustrate with arrays — illustrate with number line — illustrate with product grid	— combine equivalent sets — illustrate concretely — illustrate with arrays — illustrate with number line — illustrate with product grid	M	M
		— introduce symbol (×)				
		— mastery of basic facts to 20	— mastery of basic facts up to 40	— mastery of all basic facts	M	M
			— multiply by multiples of 10 and 100	— multiply by 10's, 100's, 1000's and their multiples	M	M
			— multiply — without regrouping — with regrouping	— multiply — with regrouping — with place value grid — with algorithm	M	M
			— multiply up to a 2-digit factor by a 1-digit factor	— multiply up to a 4-digit factor by a 2-digit factor	— up to 4 digits by 3 digits	— up to a combined total of 8 digits
				— multiply with money	M	M
			— estimate by rounding off factors	M	M	M
				— check multiplication	M	M
				— one-step word problems	— one- and two-step word problems	M

65 M = MAINTAIN AND DEVELOP

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WHOLE NUMBERS — OPERATIONS

CONCEPT/ OPERATION	1	2	3	4	5	6
Division	— readiness	— meaning of division	— meaning of division — division number sentences			
		— separate a set into equivalent sets — illustrate concretely — illustrate on array — illustrate on number line	M	M	M	M
			— introduce symbol (÷)			
			— missing factor	— apply different formats		
		— mastery of basic facts up to 20	— mastery of basic facts up to 40	— mastery of all basic division facts	M	M
					— understand terms	
				— up to a 3-digit dividend by a 1-digit divisor — without remainder — with remainder	— up to 6 digits by 2 digits — without remainder — with remainder — standard algorithm	— up to 6 digits by 3 digits — without remainder — with remainder M
				— short division	M	M
				— division with money	M	M
				— division with multiples of 10	M	
				— estimate quotient by rounding off factors	M	M
				— checking division	M	M
				— one-step problems	— one- and two-step problems	M
					— average or arithmetic mean	M

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NUMBER DEVELOPMENT

CONCEPT/ OPERATION	1	2	3	4	5	6
Rounding off		— readiness — to nearest ten	— to nearest hundred	— to any of 5 digits in a 6-digit number	— to any of 8 digits in a 9-digit number	— to any of 9 digits in a 10-digit number
			— for estimation	— for estimation	— for estimation	— for estimation
					— decimals to wholes, tenths or hundredths	M
Order of operations					— some background will have to be provided before two-step problems are introduced	M
Equalities and in-equalities	— comparison of sets	— comparison of sets	— comparison of numbers introduce symbols $<, =, >$	— use appropriate symbols $<, =, >, \neq$	M	M
Roman numerals			— read and write Roman numerals up to 20 or XX	— recognize and translate numbers I, V, X, L, C, D, M into Hindu-Arabic or decimal equivalents — read and write numbers I to C	M — read and write numbers I to M	M

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FIELD PROPERTIES

CONCEPT/ OPERATION		1	2	3	4	5	6
Commutative			— for addition — for multiplication	M — for multiplication	— apply to addition — apply to multiplication	M M — apply to fractions	M M M
Associative			— for addition	M	— apply to addition — apply to multiplication	M M — apply to fractions	M M M
Identities	Additive (zero)		— property of 0 in addition — property of 0 in subtraction — identity element for multiplication — property of zero for multiplication	M	M	M — apply to fractions	M — identity element for subtraction M
	Multiplicative (one)			— property of 1 — property of 0	M	M	— identity element for multiplication
Distributive					— apply to multiplication	M — apply to division	— apply to multiplication, no addition — apply to multiplication

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NUMBER THEORY

CONCEPT/ OPERATION	1	2	3	4	5	6
Patterns	— concrete patterns— recognize, reproduce, continue	M — describe	M	M	M	M
	— action patterns— reproduce, continue	M	M	M	M	M
	— pictorial patterns— recognize, reproduce, continue, describe orally	M	M	M	M	M
	— identify man-made and natural patterns in environment	M	— relate to art, social studies, music, science	M	M	M
			— numerical patterns	M — hundred grid — addition grid — product grid	M	M
			— even and odd	M	M	M
			— factors	M	M	M G.C.F.
					— multiples	M
			— readiness for prime and composite	— prime and composite numbers	M	M
					— rules of divisibility for 2, 5, 10	— rules of divisibility for 2, 4, 3, 6, 9, 5, 10
Exponents						— application in measurement, in factoring, in place value, in expanded notation
Arithmetic mean					— average	M

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FRACTIONS

CONCEPT/ OPERATION		1	2	3	4	5	6
Meaning		— informal introduction of $\frac{1}{2}$ and $\frac{1}{4}$	— $\frac{1}{2}, \frac{1}{4}, \frac{1}{3}$ — illustrate — name and write symbols	— $\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \frac{1}{10}, \frac{1}{100}$ — as part of a unit — unit fractions — as part of a set — non-unit fractions — relate $\frac{1}{10}$ and $\frac{1}{100}$ to decimals	M M	M M	M M
Terminology					— proper fraction — numerator — denominator	— improper fraction — mixed number	M
Comparison of					— equivalent fractions	M — set of equivalent fractions — reducing fractions — ordering fractions	M M — ordering — comparing
Operations	Addition				— like denominator and sums <1	M — sums $=$ and $>$ 1 — proper fractions—unlike denominators — improper fractions — mixed number with unlike denominators — vertical and horizontal notation	— proper fractions — improper fractions — mixed numbers — combinations
	Subtraction				— like denominators — one minus a proper fraction	— proper fractions—like denominators — mixed number minus proper fraction—like denominators — whole number—proper fraction — whole number—mixed number — mixed number—mixed numbers — horizontal and vertical notation	— proper fractions — mixed numbers — combinations
	Multiplication						— fraction × whole number — whole number × mixed number
Problem solving		75				— apply to one- and two-step word problems	— step problem

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DECIMALS

CONCEPT/ OPERATION		1	2	3	4	5	6
Meaning			— readiness for decimals, $\frac{1}{10} = 0.1$	— rename unit fractions as decimals — tenths — hundredths	— express fractional parts to two decimal places	— 100 grid — place value grid — re money — re SI	— re number line M M M M — re numeration system
						— read and write up to 3 decimal places — write in expanded notation	M M
Rounding off						— to wholes, tenths or hundredths	M
Operations	Addition and Subtraction					— using tenths, hundredths, thousandths, or combinations — horizontal and vertical format — apply to one- and two-step problems	M
	Multiplication						— decimal × whole numbers — whole numbers × decimal — apply in one- and two-step problems
	Division						— up to a 3-digit decimal divisor by converting to whole numbers — apply to one- and two-step problems
Conversion						— rename decimals as fractions up to 3 places	M

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NUMBER DEVELOPMENT

CONCEPT/ OPERATION	1	2	3	4	5	6
Percent						— identify percent — as a fraction with denominator of 100 — as a two place decimal — as a ratio — rename percent — as a fraction and vice versa — as a decimal and vice versa
Ratio						— formats 2 to 5 2 : 5 $\frac{2}{5}$
Proportion						— as comparison of two equal ratios

GRAPHS

CONCEPT/ OPERATION	1	2	3	4	5	6
	— concrete—construct, interpret (one-to-one)	M	M	M	— steps in graphing M	M M
	— concrete bar—construct, interpret (one-to-one)	M	M	M	M	M
	— pictograph—construct, interpret (one-to-one)	M	M	M — one-to-many	M	M
			— bar graph—construct, interpret (one-to-one)	— vertical — horizontal one-to-many	M	M
				— line graph—construct, interpret, one-to-many	M	M
					— number pairs — ordered pairs	M — first quadrant
						— simple circle graphs—interpret only

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MEASUREMENT

CONCEPT/ OPERATION	1	2	3	4	5	6
Linear	— non-standard — standard units	M	M	M	M	M
	cm m	— estimation	M	M	M	M
		— one-place decimal re measurement	— two-place decimal re measurement	M	M	M
			— relationship among m, dm, cm	M	M	M
				— kilometre — add and subtract units		
				— perimeter — estimate and measure	M	M
Area	— readiness	— readiness — estimation	— non-standard — standard cm^2 (no formula) m^2 — estimation	M M	M — km^2 M	M M
Volume	— readiness	— readiness — estimate	— non-standard units order by volume — estimate	M — standard units cm^3, m^3, dm^3 — no formula and estimate	M M — no formula — estimate	M — discover formula — estimate
Capacity	— readiness	— non-standard — standard litre — half-litre	M M 1ℓ = 1000 ml	M — add and subtract capacity measures	M	M
			— order containers by capacity — estimate	— estimate	— estimate	— estimate
	83					84

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MEASUREMENT

CONCEPT/ OPERATION	1	2	3	4	5	6
Mass	— readiness	— non-standard — standard— kilogram — estimate	M — estimate	M kg gram — estimate	M — add and subtract mass measures — estimate	M — to three decimal places — estimate
Temperature		— read and interpret Celsius thermometer	M	— read and interpret Celsius thermometer above and below zero	M	M
Time	— divisions of day — days of week — begin calendar — months of year	M	M — yesterday, today, tomorrow	M — estimate time — measure time — hours in day — days in week, month, year — weeks, months in year — add and subtract units of time	M — relationship among time units — SI date format — 24-hour clock — digital clock — add and subtract time units	M
Telling time	— to the hour	— by the hour — by half-hour — by quarter-hour	— to nearest five minutes on 12-hour clock	— to nearest minute — tell time on 2 ways — a.m., p.m. — change hour to minutes or vice versa	M	M
Money	— identify and name 1¢, 5¢, 10¢, 25¢, coins	— identify and name coins and one dollar bill	M — problems related to money	M M — problem involving addition subtraction multiplication division	M	M

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GEOMETRY

CONCEPT/ OPERATION	1	2	3	4	5	6
Solid (3-dimensional)	— awareness of shapes — ball (sphere) — can (cylinder) — box (cube, cuboid) — cone — recognize 3-D shapes — classify 3-D shapes	M	M	M — cube, cone, sphere, cylinder, pyramid, rectangular prism (cuboid), triangular prism — combine shapes	M	M
Plane (2-dimensional)	— awareness of square, rectangle, circle, triangle — recognize 2-D shapes — compare 2-D shapes — classify 2-D shapes	M	M — similarities — differences	M	M	M
		— faces, edges corners	M — locate (do not define)— angles, parallel lines, straight lines, curved lines	M M	M — line segments — open and closed curves — parallel lines — perpendicular lines	M M — curves — lines
			— many-sided regular shapes— 3, 4, 5, 6 sides	M	— classify polygons— 3, 4,, 5, 6 & 8 sides	M
			— reproduce square, rectangle, line segment — perimeter (no formula)	— measure a line segment		
	— recognize symmetry in 2-D shapes	M	— line of symmetry	— axis of symmetry	M	— polygons and symmetry
				— right angles — non-right angles	— compare given angle with a right angle	— angles— name parts and label — measure with protractor — classify angles— acute, right, obtuse, straight, reflex, complete revolution

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GEOMETRY

CONCEPT/ OPERATION	1	2	3	4	5	6
Plane (Cont'd)					— right triangles — non-right triangles	— triangles— scalene, isosceles, equilateral
						— quadrilaterals rectangles squares parallelograms
				— congruent plane shapes	— congruent line segments	M
						— introduction of circle: centre, radius, diameter, circumference
Transformation				— slide — flip — turn	— identify a motion as a slide, flip, or turn — find examples of a slide, flip, or turn in the environment — create designs by sliding, flipping, or turning shapes	M — test shapes for congruency after a slide, flip, or turn — combination of slides, flips, and turns M
Problem solving	— oral problems — represent concretely — do the action — describe orally the action — give the answer	— oral problems M	M	M		
		— written problems	M	M		
				— one-step word problem	— word problems— one-step, two-step	M
			— begin developing system	— problem solving procedures	M	M
Estimating			— re addition subtraction	— multiplication — division — rounding off	M	M

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KINDERGARTEN

Introduction

Since kindergarten is now available to a large percentage of the population of Manitoba, it was felt necessary to include a kindergarten section in the mathematics curriculum guide.

The suggestions included are based upon the philosophy that children should be active participants in the learning process. Consequently, the basic approach will be one of involvement through activities which should be informal, integrated, and take into account the children's innate curiosity. There must be an abundance of manipulative experiences through which events and relations are investigated at an intuitive level.

Mathematics at the kindergarten level is considered an integral part of the child's social and language development. Mathematical concepts can and should grow out of activities which are meaningful to the child and which involve interaction and discussion.

The kindergarten program is strictly a readiness for, but does not introduce formal number work.

- — This program includes the following topics: measurement, graphing, awareness of shapes, and readiness for numbers.
- — An approach is suggested which integrates mathematics and language development with science, social studies, physical education, and music, wherever possible.
- — The nature of the program is such that it allows for maximum flexibility.
- — A basic mathematics vocabulary list is included.
- — The following is a suggested thematic approach.

Theme: Fall or Getting Ready for Winter

A. Trip to a nearby park or school ground: leaves, trees, seeds, pine cones, acorns, etc.

NOTE: Language development, physical education activities, music.

B. Follow-up — Mathematics:
    sorting leaves, etc.
    comparison — shape, colour, size, etc.
    graphing — paste leaves on pictograph
  — Science discussion: wind, rain, frost, cold, squirrels, etc.
  — Language experience chart
  — Social Studies: raking leaves at home
  — Art: make patterns with leaves
  — Drama: dramatize falling leaves, wind blowing, raking, sound effects (wind), language. How do we get ready for winter?

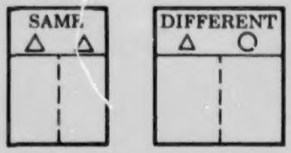
Several themes can be developed over the year: Christmas, Rain, Snow, etc.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Readiness activities: These types of activities lend themselves to the development of sorting and can be started very early in the year (even on the first day) by familiarizing the children with the classroom set up: there is a place for the coats, a book corner, a doll centre, a block corner, the rack for the scissors, a container for paint brushes, etc. *Suggestion:* Place a variety of classroom objects (a doll, a jacket, a book, etc.) around you. Then have a child choose one of the objects and place it where it belongs in the room. (Elicit a reason why it belongs there.)	—doll —jacket —book
I. SORTING (INFORMAL) **The student should be able to sort objects into sets:**		
A. by colour	*Informal activities:* These types of activities lend themselves to sorting by colour. Children need not know the colour name, but should be able to find the matching (same) colour. *Colour Week:* Make each week a different colour and encourage children to contribute items to the collection of things in the colour of the week. Language development is all important here. The children are to talk about what they have brought to school.	—Cuisenaire rods should be used where appropriate and where teachers are familiar with the Cuisenaire materials —sets of coloured blocks —Unifix attribute blocks —box of "junk" —material (lots of colour)
	Gym game: Tack four or five large coloured papers in well-spaced places. Have the children take one coloured ribbon from a box in the centre of the room and when they hear the signal, to run "home" (which is the same colour as their ribbon).	—coloured ribbons —corresponding coloured paper
B. by size	*Sorting by size:* This implies the development of measurement. (Perception of gross differences.) Initial experiences might include differentiating between: big and little large and small long and short thick and thin	—boxes (big and little) —toys (large and small) —used crayons —books (thick and thin) —ribbons, wool, straws, popsicle sticks (for length)
	Gym activity: Ask the children to make themselves as tall as they can, or as short as they can.	

Concepts and Skills are indicated in Bold Face.

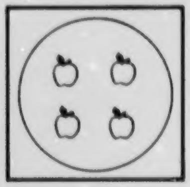
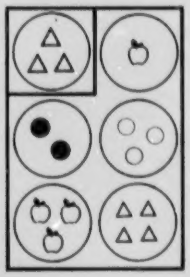
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. by shape	The environment provides us with a great variety of three-dimensional objects. These can be sorted for similarities and differences in shape.	—tin cans, plastic bottles, spools, utensils (pots and pans)
	Structured materials such as attribute blocks, flannel cut-outs, etc., lend themselves to a lot of sorting by the children. Terminology need *not* be stressed, but the children should be encouraged to describe the shape by its particular attribute ("roundness", or "has corners" or "rolls", etc.).	—attribute blocks —flannel cut-outs
D. for their own reasons	There is a real opportunity for integration when using materials for sorting: Science: — experiments for floating or sinking — magnets — attracts, does not attract — domestic animals, wild animals — animal homes — sensory experiences involving touch, smell, hearing (loud and soft) — heavy and light	—people pictures —animal pictures —fruits and vegetables and/or pictures of the same —nuts (Christmas time) —items made from cork, plastic, wood, metal —buttons —keys —toys
	Social Studies: — transportation — cars, buses, bikes, boats, etc. — shelter	
	The findings from these experiences could be recorded in a variety of ways: — labelling the groups (pictorially or with word labels) — making a concrete graph using the objects (keep in mind one-to-one correspondence) — making a pictograph — using the pictures of the collections	—soap —hammer —nails —shells —macaroni —soup and vegetable tins with labels
	NOTE: It is most logical to begin sorting first into two groups and later into three or four groups for graphing purposes. It is of the utmost importance to engage the children in conversation (oral interpretation of their experiences and their findings) as this will contribute to the total language development.	
	Use as much material as possible from the children's environment (home and school). This will enable them to compare, sort and discuss.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
II. COMPARING TWO OBJECTS The student should be able to: A. compare two objects and show (explain) the difference or similarity	Select two objects which are to be examined for likeness or difference, e.g., large beachball and a golfball — where size, colour, texture, mass and use could be discussed. Following many experiences of a similar nature, you may select one object for examination. The children may select one object from a set of objects and state whether it is the same or different from yours (discuss).	—rocks —leaves —peas and beans —blocks —toys —dishes —clothes —shoes —pictures —plastic container boxes
B. select and/or make an object that is: 1. bigger than a given object 2. smaller than a given object	Make a simple model (ball) in plasticine. Then ask all the children to make a ball that is bigger than the model, and then one that is smaller than the model. Where possible, engage the children in independent activities involving sameness and difference of two objects, etc. Given a box of objects and two large cards (see materials), have the children select sets of two objects that are the same or different and have them place the sets of objects on the appropriate cards.	—plasticine —other material, i.e., balls blocks boxes —several containers with well-selected objects (as above) —several sets of cards (30 cm x 40 cm) 
III. SORTING — CLASSIFYING (FORMAL) The student should be able to find the object(s), from a set of many objects, having: A. one specific attribute or characteristic — colour — shape — size — texture — mass — others	*Formal Activities:* These types of activities (structured) consist of sorting a variety of objects according to an attribute selected by you, e.g., from a given set (box of objects) have the children find all the things that are round, or all the things that are red, etc.	—hoops —boxes or sorting trays —tickets or labels (which indicate an attribute where possible), e.g., ○ △ RED

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. two attributes	Once children have had many experiences in identifying attributes, *some* children might be ready to find objects that are: red and round, white and can roll, blue and large, hard and shiny, etc. *Reinforcement activities:* — Have the children sort objects independently according to their own preferences. Then have them give their reasons for sorting the objects the way they did. — Ask the children to try to sort the same objects in a different way, e.g., from a container having an assortment of crayons (old ones and new ones) sort for: colour, old and new, long and short, with paper on or without, broken or not broken.	—a good variety of objects that are distinctly different —attribute blocks —buttons —bottle caps and lids, corks —wooden beads —seeds —leaves —nails —screws —crayons (old and new) —straws —toy dishes —old jewellery —marbles
IV. COMPARING SETS **A. One-To-One Correspondence** The student should be able to compare two sets of objects and determine which set has:	The vocabulary used in these activities should primarily be related to crude comparison, such as: more, less, many, few, a lot, as many as, etc. This vocabulary will grow out of experiences of comparing sets with gross differences in quantity by: a. comparing visually (which is a form of estimating) b. matching (one-to-one to verify)	—large and small collection of objects (as above) —pegboards
— more — less — as many as	Involve children in experiences which are meaningful, e.g., a number of children, a smaller number of chairs — a. compare — more children than chairs? b. match — one child for one chair (verify) — less or fewer chairs than children?	—use physical education material —objects from science collection —objects from social studies —pictures from various sources
	Other activities: — Compare a group of boys and a group of girls (same procedure as above). — Have a table setting experience for four children, for example, let the children help set the table (one takes care of the cups, another takes care of the saucers, etc.). — Give children ample opportunity to help hand out enough material to a group of classmates. *All of the above are essential pre-number experiences.*	—cups —saucers —table

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Reproduction of a Set **The student should be able to make a set of objects having:**		
1. as many as the given set **(equivalent)**	Have children reproduce a set that has as many things as a given set. This activity should be done by children in pairs so that they can compare their sets.	—sets of objects that are fairly similar —sets of a variety of objects
2. more than the given set **(larger than)**	Have children take turns at doing these activities. Have them say which set is larger (or bigger) or which set has more than the given set.	
3. less than the given set **(smaller than)**	— Place two plasticine balls in a box lid. In pairs ask the children to make more than, less than or as many as the model. Always precede pictorial work by concrete experiences.	—plastic lids —plasticine
	Here again, the above activities are pre-number experiences, where no formal work on numbers is introduced.	—picture cards with sets of things, clearly and simply represented 
V. **EQUIVALENT SETS (MATCHING SETS)** The student should be able to:		
— find the sets (from many sets of objects) that have as many things as the given set	— Given four or five sets, have the children find the sets that have as many things as the given set. — From a prepared picture page, as illustrated, have the children cut out all the sets that have as many things as the given set (see materials). Paste the sets on a new sheet with the given set.	—pie plates or box lids or small trays (each containing a number of objects) 

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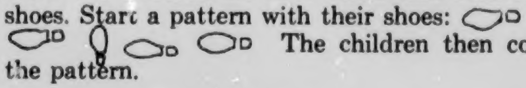
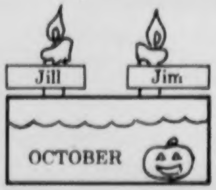
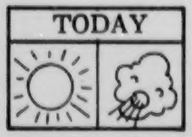
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	— From a deck of picture cards (representing sets), have the children find all the cards that have as many things in the set as the card posted on the board.	—collection of cards with sets —use rubber stamp pictures, or stickers to construct cards
VI. PATTERNS **A. Reproducing** The student should be able to reproduce a given pattern:	Pattern building is a vital part of the development of numbers. It is experienced by the children aurally, visually and physically. The development is multi-sensory and sequential. Initially, have the children simply copy or superimpose a pattern. This can be done with parquetry blocks, colour block pattern cards or with a given model (very simple pattern).	—identical material for teachers and children —parquetry blocks —colour block pattern cards —beads
1. concretely	The following steps are suggested:	
	— *Straight reproduction* (visual and tactile) a. Show two acorns and one bottle cap. Have the children select the same items and place them below the model in the same order.	—acorns —bottle caps
	b. Hang clothes on a miniature clothesline: socks, slacks, shirt, etc. Ask the children to reproduce the same pattern on an identical clothesline.	—two sets of various articles of clothing —miniature clothesline (two)
	c. Try many more activities of a similar nature with the children.	
2. by seeing and doing	— Arrange the children in pairs side-by-side. Have one make a simple pattern and have the partner reproduce that pattern (VISUAL PATTERN).	—boxes with (things) material in duplicate —picture cards
3. by listening and saying	— Give children a verbal pattern, e.g., clap, clap, stamp or zoom, zoom, boom. Have the children reproduce the pattern individually or in groups (AUDITORY PATTERN).	—refer to Orff method in music
4. by listening, seeing and doing	— Use patterns in physical education, e.g., using a ball — bounce, catch, bounce, catch; or touch toes, knees and hands up, etc.	—physical education material

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Continuing **The student should be able to:** **— find what comes next in a continuing pattern**	Start a pattern and have children continue it. Later, have the child start a pattern and have the others continue it. Much work should be done using the objects from around the room. e.g., a. Have the children sit in a circle and remove their shoes. Start a pattern with their shoes:  The children then continue the pattern. b. Start the pattern: boy, girl, girl, boy, girl, girl. The children then continue the pattern. Invite children's suggestions for different patterns. c. Start the pattern: clap, tap, tap, clap, tap, tap, etc. The children then continue until the stop signal is given. Encourage the children to give variations.	—runners —blocks —flannel cut-outs, etc.
C. Building **The student should be able to:** **— create a pattern**	In these activities, have the children attempt to make their own patterns by using multi-media material. Much of this can be done in print-making using pieces of sponge, corrugated cardboard, vegetables (carrots, potatoes, etc.).	—parquetry blocks —pattern blocks —beads —sets of attribute blocks —macaroni (elbow) —glue —pop beads —straws and Fruit Loop cereal —styrofoam fill —animal and flower stamp sets —pieces of sponges —pieces of corrugated cardboard, vegetable pieces —poster paint

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VII. ORDERING **The student should be able to arrange a set of objects in order:**	Initially begin with two objects then proceed to three.	
A. by size	An interesting introduction to ordering could well be the reading and discussion of stories such as: "The Three Bears". Besides the inherent work on one-to-one correspondence, the story reinforces constantly the concept of small, middle-sized and big. To enable the children to differentiate, it is essential that cut-outs of the bears and all the objects be available so that the children can place them in the right order over and over again. Oral expression should also be encouraged. Dramatize the story. Let the children choose the characters and the appropriate corresponding material to be used in order to re-enact the story.	—good size illustrations of the story —cut-outs of the three bears (very obvious difference in size), beds, chairs, etc. —real life-size material—chairs of different sizes, bowls —outlines of beds (using either wooden blocks, sticks, ropes or tape)
B. by length (height)	To further develop and reinforce the concept of ordering, the most meaningful activities are those which involve people. e.g., 1. Compare the teacher's height and a pupil's height. Which is tallest, shortest — discuss differences. 2. From a box of balls or wooden blocks obviously different in size, have them find the smallest, the biggest, and a middle-sized ball or block. 3. From a box of pencils or straws which are obviously different in length, have the children find the shortest, the longest, and a middle-sized one. *Reinforcement of A and B* — Have the children arrange flannelboard cut-outs in order. Given a prepared sheet, have them cut three items: small, large, and middle-sized, and tell them to paste them in order. NOTE: The concept of first, second and third may be introduced as it relates to children lining up in a row.	—variety of balls, e.g., marble, tennis ball, basketball, etc. —blocks (all cubes) different in size —triangles (different in size) —Cuisenaire rods —flannel cut-outs —variety of straws —variety of pencils

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VIII. TIME **A. Division of the Day (Morning, Noon, Afternoon, Night)** **The student should be able to:** — name parts of the day and associate a specific event with the appropriate part of the day	The passing of events should be part of the children's experiences and be measured in relation to these experiences. (This does not mean reading a clock.) Help children put daily happenings in order and have them say in which part of the day they occur. Separate charts could be constructed — each one dealing with one part of the day, e.g., pictures depicting morning events will be pasted on one chart, afternoon events on another, etc. Then have the children properly name and title the pictures, MORNING, AFTERNOON, etc. When constructing the charts, engage the children in discussions related to the events. Encourage the children to bring more pictures to complete the charts. Give each child an opportunity to talk about his or her picture. When all charts seem complete, hang them side-by-side in sequential order to form a mural depicting a "day".	—pictures — cut-outs of specific events, e.g., child getting up
B. Sequencing Events **The student should be able to:** — put events in sequence (first two events, later more than two events)	Many opportunities will arise to question and discuss what activities the children prefer to do each day. Have them find on the big chart, when these activities take place. (This is excellent for language development and interdisciplinary activities.) Refer to the Elementary Science guide on time development. Read or tell very short stories. Have the children recall two or three events in proper sequence. (What happened first, and then, and then . . .) Encourage children to make up their own stories.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Division of the Year (According to Special Events, Birthdays, Easter, Valentine's Day, Canada Day, etc.) **Readiness**	The following is an activity which may help the children in the development of this difficult concept. (This is to be treated as readiness — *not* as formal instruction on the months.) Have each month represented by a large birthday cake picture, properly labelled with the name of the month, and which also has a picture of the special event of the month (see materials), e.g., September could have a picture of children coming to school, etc. Children will learn to associate special events to certain months, especially their own birthday. A candle with the child's name could be cut out and placed on the cake. Include July and August near the end of the school year and have the children discuss the holiday time. If at all possible, place the cakes in proper sequence to cover the whole year. This can be done by using the cake of the month.	
D. Yesterday/Today **Readiness**	This very difficult concept can be gradually developed if it is related to specific events, e.g., keep a record of each day's weather. Near the end of each day, have the children decide what kind of a day it was outside. Display this clearly on a chart using special illustrations (snowman, umbrella, sun, wind, etc.).  Make a set of labels which are easily removable and which can fit into slots — one set for "Yesterday" and "Today", and one set of pictorial weather labels. On the following day, discuss what kind of day it was yesterday. (Do they remember, etc.). Change the label from "Today" to "Yesterday". At the end of the day, discuss both days.	—two small pocket charts or small flannelboard —two labels (YESTERDAY — TODAY) —set of weather labels (pictorial)

Vocabulary List

Concepts of:

Size — big, little, small, large, tall, short, long, thick, thin

Shape — round, squares

Texture — rough, smooth, hard, soft

Capacity — empty or full — box, jar, glass, hand

Quantity — all, some, many, lots of, whole, each, more, less, same as, a pair, few, one-half, more than, less than, none, nothing

Measurement — heavy, light; hot, cold; faster, slower; fastest, slowest; fast, faster, fastest; taller, shorter; tallest, shortest; tall, taller, tallest; short, shorter, shortest; more, most; higher, lower; highest, lowest; biggest, smallest; bigger, biggest; large, larger, largest; small, smaller, smallest

Position — up, down; in, out; on, off; front, back; beginning, end; first, last; before, after; high, low; left, right; under, over; next, last; top, bottom; close, closer; middle, above, below; behind, in front of, beside

Time — fast, slow, quickly, slowly, night, day, morning, afternoon, evening, yesterday, today, fall, winter, spring, summer, days of week, months, holidays

Geometric Terms — may be introduced *informally* — circle, triangle, rectangle, cone, cube

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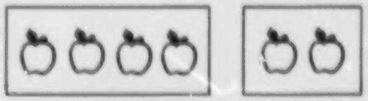
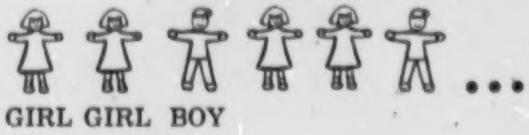
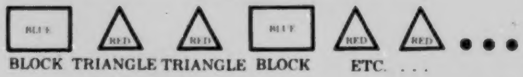
22
23
24
25
26
27
28
29
30
99
100
RD
0+5
1+4
3+2
5
4+1
2+

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. READINESS FOR NUMBER DEVELOPMENT		
A. Comparison of Two Objects (Two Sets of One) The student should be able to:	Vocabulary is developed through activities that involve extensive use of concrete materials from the child's environment. The students should have multiple experiences sorting and classifying objects into sets, these activities are initially exploratory, then teacher-directed (see kindergarten section).	
1. compare two objects for difference or similarity in: colour, size, thickness, etc., using appropriate vocabulary 2. compare position of objects using appropriate vocabulary	By means of two objects or pictures of two objects, check the pupil's knowledge of such terms as: different, same, larger, bigger, smaller, longer, taller, shorter, wider, narrower. Introduce the terms they do not know at the appropriate time. Vocabulary for position: using suitable objects and later pictures, check the pupil's knowledge of such terms as: above, below, over, under, before, after, first, last, between, behind, in front of, etc.	—books —boxes —leaves —stones —windows —shoes —juice cans —soup cans
B. Comparison of More Than Two Objects (Two or More Sets) The student should be able to:		
– arrange objects in order using appropriate vocabulary	Three or more objects may be used to check the pupil's understanding of such terms as: largest, biggest, smallest, longest, shortest, widest, narrowest, etc. The objects should be the same in shape but different in size (see suggested materials).	—three balls (marble, golfball, beachball) —three Cuisenaire rods —three pencils
C. Comparison of Sets **1. As Many As (Equivalent Sets)** The student should be able to:		
a. compare two sets and	Two groups of objects could be compared by one-to-one correspondence (matching) to establish the concepts in C. Terminology (equivalent sets) not stressed at all. The use of "as many as" is preferred initially.	
i. identify a set that has as many elements as another set	Two children compare their sets for equivalence by matching. They use their own vocabulary to express their findings.	—bottle caps —counters —bingo chips —blocks —rods —beads —flannel cut-outs (board) —magnetic board with cut-outs —pictures of things
ii. concretely reproduce a set equivalent to a given set	One child has a given set, another child is asked to make a set equivalent (with as many things) to the first child's set. Use concrete material.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
iii. sort out the equivalent sets from a number of sets	Given several sets, find those that have the same number of objects (equivalent sets).	
iv. pictorially reproduce a set equivalent to a given set	Pupils draw a set or group which is equivalent to a given set or group.	
2. More Than The student should be able to: — identify a set that has more elements than a given set	Which set has more apples? Use concrete material. 	
3. Fewer Than (Less Than) The student should be able to: — identify a set that has fewer elements than a given set	Which of the two sets (or groups) has the fewer objects? The above concepts are developed through various activities using concrete materials and later pictorial material and through continually encouraging children to express their findings orally.	
D. Patterns **1. Concrete** The student should be able to: a. recognize, reproduce, continue, and describe orally a concrete pattern	See kindergarten section for introduction to patterns. The teacher should make a pattern using children as models. e.g.,  The students are encouraged or challenged to determine (discover) the pattern: a. by telling b. by continuing the pattern (using actual boys and girls) c. by reproducing the pattern (using cut-outs of girls and boys) This activity should be repeated many times to produce a variety of patterns, e.g., blocks and/or geometric shapes, with differences in shape, size, colour.	—felt boards —felt shapes —counters —pictures —newsprint folded to facilitate spacing a pattern —attribute blocks —parquetry tiles —beads

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. reproduce and continue an action pattern	Activities leading to improvement of listening skills should happen frequently. e.g., spoken words 1. out, out, out, over, out, out, out, over 2. clap, clap, stamp, clap, clap, stamp — action pattern 3. bounce, bounce, catch, bounce, bounce, catch — use a ball in physical education class	—tapes or records of sound patterns —balls —drum
2. Pictorial The student should be able to: **— recognize, reproduce, continue, and describe orally a picture pattern**	The student should construct a pattern using blocks. e.g., geoblocks  BLUE RED RED BLUE RED RED BLOCK TRIANGLE TRIANGLE BLOCK ETC. . . . These should then be traced to produce a pictorial pattern. The student should describe the pattern orally, e.g., blue, red, red, blue, red, red, ... or square, triangle, triangle, square, triangle, triangle	—geoblocks —collections of pictures —attribute blocks for tracing —other objects suitable for tracing
3. Patterns Around Us The student should be able to:		
a. identify patterns around us i. man-made ii. natural	Here is an excellent opportunity to integrate with science and art. Observe and discuss patterns and symmetry around us, e.g., decorations, buildings, wallpaper, wrapping paper, fabrics, etc. When opportunities arise use insects, flowers, leaves, fruit, animal markings, etc., to develop awareness of patterns.	—wallpaper —patterned wrapping paper —fabric —pictures of animals —pictures of flowers —leaves
b. create individual patterns in a variety of ways	Students should explore pattern making by using various concrete and pictorial materials and be introduced to printmaking. Correlate with the art program.	—stamp pad —vegetable printing —corks —bottle caps —paint
E. Counting The student should be able to:		
1. rote count at least up to 10	Introduce poems, songs and games which involve number sequences (rote counting). This counting involves starting at one, and going up to ten or higher, as well as counting down.	—"Count Down": construct rocket, on blast off child pulls string to lift rocket

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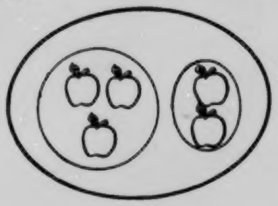
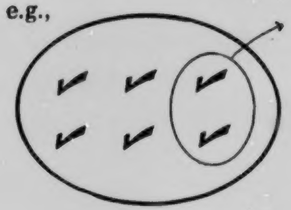
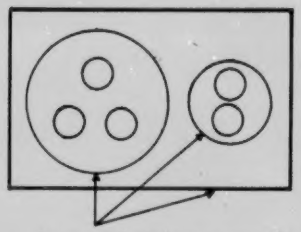
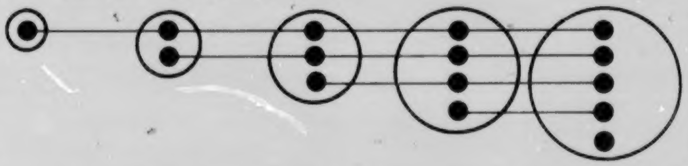
Concepts and Skills are indicated in Bold Face.

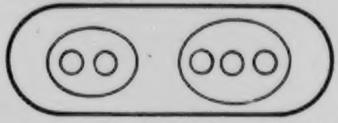
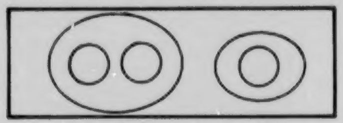
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. enumerate (rational counting) using the natural numbers, 1, 2, 3, . . .	Different sets of objects may be used to help the child to identify the number of objects in a set in answer to the question — How many? Buttons on jackets, windows in a room, children in a group, crayons in a box, etc., may be counted. A well-selected picture or poster could help to motivate children to identify (count) groups (or sets) of children, flowers, animals, buildings, etc., as well as promote the development of meaningful vocabulary. The number of objects in the sets should be gradually increased. For example, sets of 1, 2, 3, 4, and 5, should be dealt with before proceeding to 6, 7, 8, 9, and 10. Pupils learn that the last number counted is the *cardinal number* (how many items in the set). *Ordinal numbers* may be introduced when the opportunity is present.	—material from the immediate environment —suitable pictures or posters —blocks —buttons —beads —pennies
F. Readiness for Addition and Subtraction The student should be able to: 1. combine two sets to form a larger set 2. remove a subset from a given set	The process of addition and subtraction, *without reference to numerals or operation symbols* (+ or —), may be introduced by manipulating materials. The pupils should experience combining two groups (sets) to form a larger group and also experience the undoing of this process by separating into parts again. This is the readiness stage of addition and subtraction.	—any kind of manipulative material —loops of string or wool to surround the sets
3. combine two sets pictorially 4. remove a subset pictorially	e.g.,  e.g., 	 loops of string or wool
II. STUDY OF WHOLE NUMBERS FROM 0 TO 10 **A. Study of Numbers 0 to 5** **1. Sets** The student should be able to: a. identify sets of 1, 2, 3, 4 and 5 elements	Sets having 1, 2, 3, 4 and/or 5 elements can be selected by the child from the immediate environment (concrete or pictorial). The child recognizes them as having 1, 2, 3, 4 or 5 elements. Children may collect pictures representing sets of 1 to 5 and paste them in their own booklets or on a class chart in the appropriate place, e.g., place all the sets of four on the chart. The children are not expected to recognize the written symbol at this time.	—small cubes —Unifix cubes —Cuisenaire rods —buttons —other small counters —felt cut-outs (flannel-board) —bread tags in pill vials for individual sets of counters

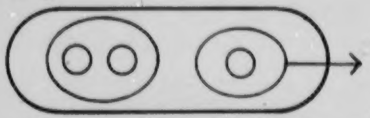
Concepts and Skills are indicated in Bold Face.

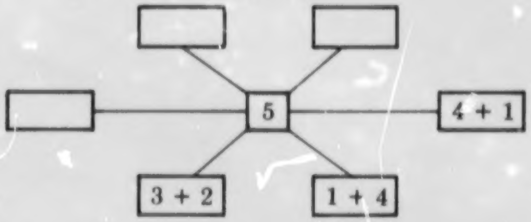
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. compare the sets of 1, 2, 3, 4, and 5 elements for cardinal values	Children could put the five sets in increasing order (from smallest to largest) and also decreasing order. Small group discussion often leads to many discoveries of the relationships between the five sets, e.g., the set with one element has the fewest number of objects. The set with five elements is the largest (has the greatest number of objects). The set of three is located in the middle of the sequence. The set of three has one more object than the set of two (three is one more than two). The set of three has one less object than the set of four (three is one less than four), etc. Relationships may be visualized by placing the objects in each set into a one-to-one correspondence. 	—small cubes —Unifix cubes —Cuisenaire rods —buttons —felt cut-outs (flannelboard) —bread tags in pill vials for individual sets of counters —straws, popsicle sticks, string, or wool to indicate one-to-one correspondence
c. order the sets from smallest to largest by matching		
d. identify an empty set (zero)	Zero will be introduced when the opportunity arises. Several containers holding objects, some holding no objects, could be used to develop the concept of zero (empty set).	—containers with sets of objects
e. concretely reproduce a set equivalent to a given set (visual)	A set (concrete or pictorial) is shown to the group of children. They are then asked to reproduce the set either with concrete material or pictorially.	—large cards with pictures of sets of things —picture flashcards with sets —1 to 5 dot flashcards
f. concretely reproduce a set equivalent to a named set (oral)	The teacher may name the set, e.g., "Make a set with three blocks in it", "Draw a set that has five balls in it", etc. These activities provide a form of evaluation as to the understanding of the number concepts (1 to 5).	
g. identify a set by its number name (cardinal value) and find the corresponding numeral	The children should now be ready to identify the numeral and relate it to a set and vice versa, e.g., a set of three things is given the number name of three and labelled with the numeral "3". The numerals 1 to 5 could be placed under appropriate sets and the numeral cards placed in order — 1, 2, 3, 4, 5 and 5, 4, 3, 2, 1. The teacher could show (not tell) a numeral and ask for the related set. Children should be given daily opportunities to recognize, trace and print the numerals. An inter-relationship is established between concrete objects, pictorial representation, oral expression (the word) and the symbol (numeral).	—small individual cards with the numerals 1, 2, 3, 4, 5 —class cards with large numerals —numerals cut out of sandpaper pasted on cards —styrofoam cut-out numerals

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
h. order numbers by: **i. finding the number before or after a given number** **ii. writing the numeral which comes before or after a given numeral** **iii. finding the number between two given numbers** **iv. writing the numeral which comes between two given numerals**	Oral counting may help the child to find the number after a given number and before a given number. The sequence of the numerals, 1, 2, 3, 4, 5, can assist the children in checking their answers.	
i. form a new set which has: **i. one more or one less object than the given set** **ii. two more or two less objects than the given set**	Children usually enjoy being used as models, e.g., one child stands in a hula hoop on the floor. One more child is asked to join. The children experience the idea that one and one more makes two, and express the happening orally. A possible expression might be, "One boy was in the hoop first. Then one more boy came in. Now there are two boys in the hoop." Or, "Three girls are in the hoop. One is called out. Now how many girls are in the hoop?" Children should be encouraged to make up their own problems related to one more and one less. These could be acted out.	—all sorts of objects —hula hoops
2. Addition		
The student should be able to: a. combine two sets to form a larger set	*Addition* is the union of sets. The idea of the commutative principle ($3 + 2 = 2 + 3$) grows out of experiences. The symbols, + and =, may be introduced when the pupils are able to verbalize with ease the action done with concrete materials and understand the operation of joining (addition). It may be easier for the child to remember the new symbols if the "+" sign is introduced first, and later the "=" sign.	—blocks —chips —pennies —flannel cut-outs —rods
b. join sets concretely	Join two sets of concrete material, e.g., 3 blocks and 1 block.	—loops — surrounds (wool, string, rope) —pictures —numeral cards —cards with operation symbols —number sentence cards with or without anwers

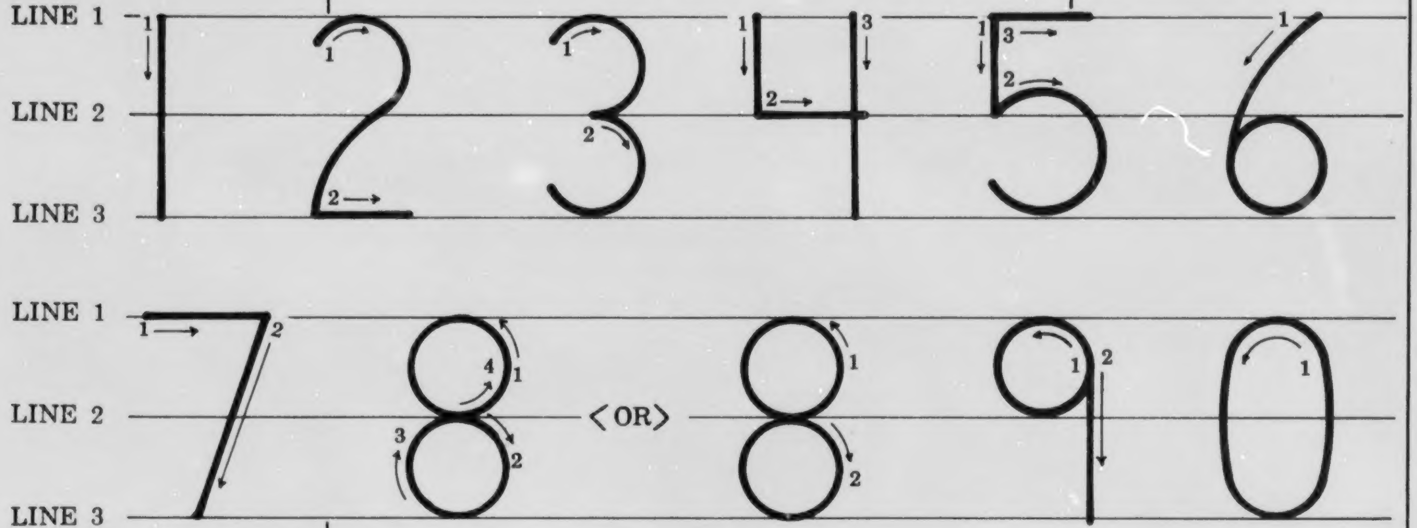
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. interpret action orally	The children might interpret this as, "Three blocks and one block makes four blocks."	
i. read the number sentence	The teacher could write a corresponding number sentence, e.g., 3 and 1 are 4.	
ii. associate "and" with "+" and read the new sentence	The sentence could be rewritten introducing the plus symbol, e.g., 3 + 1 are 4. The child is still allowed to read this as 3 and 1.	
iii. read the number sentence using symbols	When the child is familiar with the "+" symbol, the "=" symbol may be introduced, e.g., 3 + 1 = 4. *(The time of the introduction of the terminology, "plus" and "equal" will vary with the maturity of the child.)* The child could be asked to match the number sentence card, e.g., $\boxed{2 + 3 = 5}$ with the appropriate pictorial representation, e.g., 	
d. interpret a given number sentence concretely	The children should be able to read a number sentence and interpret its meaning with concrete material.	
e. combine two sets and write the number sentence	The teacher or the child could combine two sets and the child should be able to write the corresponding number sentence.	
i. represent concretely and/or pictorially, oral addition problems	Children may now be able to represent addition problems with concrete or pictorial material, e.g., Susan had 2 pennies. She found 1 more penny. How many pennies has she now?	
ii. write the corresponding number sentence	 2 + 1 = 3	
3. **Subtraction (Inverse of Addition)** The student should be able to: a. remove a subset from a given set	*Subtraction is the removal of a subset from a given set.* The introduction of the "—" sign should be an interpretation of the action of removing or taking away.	—hula hoops —pennies —various blocks —flannel cut-outs (flannelboard) —magnetic material —pictures (cut-outs)

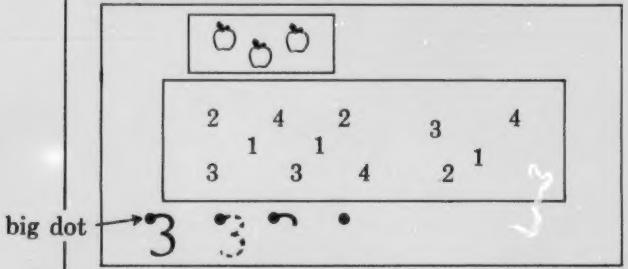
CONCEP[illegible]ILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. remove a subset concretely	After having joined two sets, remove one subset. This reinforces the idea that addition and subtraction are inverse operations, doing and undoing.  It is advisable to have concrete material so that actual removal can be done.	
c. interpret the action orally	The children might interpret b) as, "There were three things. One was taken away. Now there are only two left."	—number cards and operation symbol cards
i. read the number sentence	The teacher could write a corresponding number sentence, e.g., 3 take away 1 are 2.	—number sentence cards with or without answers
ii. associate "take away" with "—" and read the new sentence	The "—" sign could now be introduced. The number sentence which will correspond with the oral statement will now be written as 3 — 1 = 2. The child may still read, "Three take away one are two."	3 — 1 3 — 1 = 2
iii. select the right number sentence for the picture	The child could be asked to select the appropriate number sentence card from a series of cards, e.g., 3 — 1 = 2, under the pictorial representation.	—several number sentence cards
d. remove a subset and write the corresponding number sentence	The teacher asks the student to remove a subset from a larger set and write the corresponding number sentence.	
i. represent concretely and/or pictorially an oral subtraction problem	Children may now be able to represent subtraction problems with concrete or pictorial material, and write the corresponding number sentence.	
ii. write or select the corresponding number sentence	When children are given a problem to solve, they should be able to write or select the correct addition or subtraction sentence, or card.	
4. Differences by Matching The student should be able to: — find the difference between two sets by matching	*Subtraction is finding the difference by comparing two sets,* e.g., John has 4 pennies. Jim has 3 pennies. Who has more pennies? How many more? This should be done by comparing 2 sets of concrete material (matching). Are 4 pennies more than 3 pennies? How many more? Are 3 pennies less than 4 pennies? How many less? *Written number sentences using the missing addend are not required as yet.*	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. Property of Zero The student should be able to:		
a. identify the empty set by removing all objects from the given set	The cardinal value of an empty set is zero. One of the experiences could be removing all the items from a box so that none are left. Another experience would be spending all the pennies in a purse. This could well be illustrated in subtraction problems.	—boxes —counters of many kinds
b. discover that the cardinal value of a given set does not change when combined with an empty set or when an empty set is removed	The activity of joining an empty set to a given set illustrates the property of zero, e.g., 5 + 0 = 5.	
6. Maintenance The student should be able to:		
— start remembering addition and subtraction facts from 0 to 5	Throughout the study of numbers 0 to 5, learning should be reinforced and systematic practice should be provided to help the child memorize the facts. Drill is essential, but only after the concept is understood. A good variety of games, activities and problems are interesting forms of reinforcement. "Satellite Game" — addition facts  	—dot dice (styrofoam or cubes) —number dice —large dominoes —simple "Snakes and Ladders" —hopscotch —ring toss —bingo games —matching fact cards with answer cards —"Satellite Game" (see diagram)
B. Written Work **1. Write the Numerals** The student should be able to: — form the numerals correctly	It is most important to proceed slowly with formal written work. The skills required for written work must be developed in an orderly, sequential manner. Mathematical symbols are abstract and should not be introduced until the child has had many number experiences and can talk about them with understanding. A multi-sensory approach is necessary — seeing (recognizing the numeral), feeling (touching and tracing) and hearing the name of the numeral — before pupils can reproduce the numerals independently in an acceptable printed form. Initially larger models should be used.	

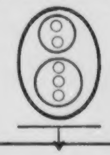
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Suggested example of procedure: following a discussion of the numeral "3", the teacher might name and/or clap "3" (the number name). After hearing the word or the number of claps, the child might be asked to select the number from a set of numerals, name it, trace it and finally print it. *The first writing of numerals requires careful supervision.* (Small group work makes this easier.) It is much easier to correct reversals at the very beginning than it is at a later stage. A suggested approach re formation of numerals.	—numerals cut out of sandpaper and pasted on manilla —numerals made of styrofoam, flannel, cardboard, etc. —chalkboard



Following this the child might be asked to complete a short assignment.

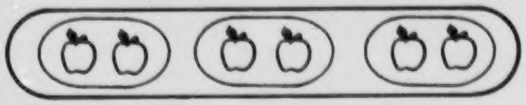
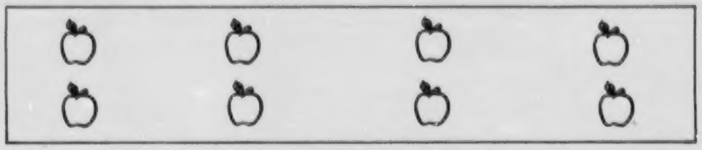


1. Circle all the 3's.
2. Trace all the 3's in the small box.
3. Trace large 3 starting at the big dot.
4. Complete the line of 3's starting at the big dots.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Numerals in Sequence The student should be able to: — write the numerals in sequence	After experiences in counting, the child might arrange the model numerals in sequence then copy this sequence. Children might be asked to fill in the missing numerals in a given sequence. e.g., 1, 2, ☐, 4, 5 2, ☐, 4, 5 ☐, 3, ☐ 3, ☐, 5	—board with hooks —key tags with printed numerals to hang on hooks in sequence —floor number line
3. Number Sentence The student should be able to: — complete a number sentence	A number story could be illustrated pictorially, then the child would be asked to select the corresponding number sentence from several sentences and copy and complete it in writing. e.g., 3 + 2 = ☐ 5 — 2 = ☐	
4. Number Story The student should be able to: — write a number sentence to represent a number story	The child can interpret a number story orally and in written form. The child writes the whole number sentence. Follow-up work, worksheets or workbook pages, should be directly related to the topic being taught. The assignments should be brief and varied to maintain the interest of the child. They are most useful for purposes of evaluation, for review, and for reinforcement of concepts and skills.	
C. Study of Numbers 6 to 10 **1. Addition and Subtraction** The student should be able to:	The study of the numbers 6 to 10 should be introduced in the same manner as the suggested study up to number 5, while continuing to reinforce facts and skills.	—same as for II A
a. use addition sentences to help solve subtraction sentences	The children should be made aware of the relationship between addition and subtraction (inverse operations) as they are progressing in their understanding of numbers up to 10.	
b. name a number in many ways	A number has many names, e.g., the number 6 can be thought of as 3 + 3, 1 + 5, 7 — 1, 1 + 1 + 1 + 1 + 1 + 1, 4 + 2, 6 + 0, etc. Children may be challenged to find as many names as they can (oral and written) for a number. This will help children to see and understand number relationships and to memorize number facts.	—"Satellite Game"
c. add two addends vertically	Vertical notation of addition and subtraction may be introduced at this time using concrete material vertically.  $\begin{array}{r}2\\+3\\\hline 5\end{array}$	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	EXTENSION: Addition with more than two addends — some children might be ready to do addition involving more than two addends.	
2. Maintenance The student should be able to: — recall the number facts (involving digits 0-5) with increasing proficiency	Encourage the children to remember the number facts through a variety of activities, games, exercises, drills, etc. NOTE: The concept of two is very important in the study of numbers. The ability to see twos in number patterns leads to an easier understanding of larger numbers. Every even number contains sets of two, without a remainder. It is just as easy and more convenient to count by twos, as by ones. The child's environment exemplifies two in many ways, e.g., two eyes, two ears, two arms, two shoes, a pair, a couple, twins, two friends, etc. In fractions the sharing between two people involves two parts or two halves. In geometry the axis of symmetry divides a shape into two congruent parts, e.g., Valentine heart shape, Christmas tree, a sheet of paper, etc.	—number games using dice — spinning wheel —number lines (walk on, cricket jumps, etc.) —dominoes (large) —flashcards —buttons (two holes, four holes) —egg cartons — arrangement of twos —shoes —mittens —glasses —scissors —symmetrical objects and shapes, etc.
D. Readiness for Multiplication and Division	The concept of multiplication and division is developed through many experiences.	
1. Equivalent Sets The student should be able to: a. recognize sets of two b. find the number of sets of two	*Readiness activities for multiplication.* Equivalent sets of two could be formed by placing the children in pairs, e.g., eight children are grouped in sets of two. Count the groups. "How many groups of two?" This could be repeated with four, six, and ten children. Different arrangements of twos can be worked out using egg cartons, bingo chips, cubes, pennies, etc., emphasizing the grouping in two and counting how many groups or sets of two.	—hoops —blocks, cubes —bottle caps —egg cartons —bingo chips —containers (plastic) and lids can be used to hold equivalent sets
c. recognize and count sets of three, four and five	The same procedure could be followed using sets of three, four, and five.	—tricycles (3's) —triangles (3's) —chair legs (4's) —car wheels (4's) —fingers, toes (5's) —gloves (5's)

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
d. reproduce concretely sets of two	Using concrete material, the children may be asked to make sets of two, e.g., two sets of two, five sets of two, etc. The children should be asked to interpret their activity orally. This is an excellent way of evaluating the children's understanding of equivalent sets (the basis for multiplication).	—domino patterns
2. Skip-Counting **The student should be able to:** **a. count by twos, threes, fours and fives**	It is advisable to maintain counting experiences by twos, and later by threes, fours and fives. EXTENSION: Count by tens.	
b. interpret a repeated addition experience orally and in writing	As the children should now be able to recognize equivalent sets, pictorial representation may now be interpreted as:  2 + 2 + 2 This can be interpreted as 2 + 2 + 2 and/or three of the 2's and/or three 2's. The operational symbol of multiplication, ×, may be introduced when the children are thoroughly familiar with the concept.	—overhead projector using small items to be grouped
c. find equivalent subsets in a given set	Many of the division concepts have already been dealt with in the multiplication readiness activities, as division is the inverse of multiplication. When the children have constructed three sets of two to make six (multiplication), it is the most logical procedure to immediately ask, "How many sets of two are in six?" (division). *No division symbol need be introduced at the grade 1 level.* The children make a set of six items (the given set). They are asked to find groups of two. Count the groups of two. How many groups of two did you find in six?	—same as for multiplication
d. count the number of equivalent sets in a given set	A larger set is represented pictorially. The children are asked to circle the sets of two. 	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
III. FRACTIONS		
A. One-Half The student should be able to: 1. share an object equally with another student 2. name the shared part of the object as one-half	Fractions are introduced through active, meaningful learning experiences such as: sharing with a friend to find *two equal parts of* a sheet of construction paper, a cookie, a piece of string or ribbon, a small jar of sand, etc. They may also share a set of objects equally, e.g., six blocks, eight bottle caps, four cookies, two candies, etc. *The main objective of the preceding activities is to develop the concept of one-half as being one of two equal parts.* The children may be given halves of various objects, and asked to find the matching half of each object. Pictorial representations of halves of objects could be prepared for the children to cut out, match and check by superimposing one half over the other to reconstruct the whole. They may share candies, cookies, etc. DO NOT WRITE SENTENCES.	—construction paper —cookies —ribbon —strips of paper —bottle caps —pie plates —Cuisenaire rods —geometrical shapes cut in halves —assignment on paper: halves of shapes at random
B. One-Fourth The student should be able to: 1. share an object equally among four students 2. name each shared part of the object as one-fourth	Introduce one-fourth as being *one of four equal parts.* Most of the above activities could be adapted for the introduction of dividing into four equal parts, e.g., sharing between four children. Children should be aware of the many ways of dividing objects into four equal parts.	—same as preceding —apples
C. Name and Write Symbols The student should be able to: — name and write symbols for the shared parts	The written symbols $\frac{1}{2}$ and $\frac{1}{4}$ *may be introduced* after the children can recognize the fractional parts and name them orally. EXTENSION: Introduce one-tenth as being one of ten equal parts—this is only as an informal preparation to measurement. $1 \text{ mm} = \frac{1}{10} \text{ cm}$	—small cards with written symbols $\frac{1}{2}$, $\frac{1}{4}$ —10 cm ruler or number line —Cuisenaire rods — 10's and 1's where appropriate

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
IV. GEOMETRY		
A. 3-D (Solid) Shapes in the Environment The student should be able to: 1. **recognize 3-D shapes** — ball (sphere) — can (cylinder) — box (cube and/or cuboid) — cone	Geometry must be informal and active. Children should become aware of three-dimensional shapes around them in their immediate environment: 1) in the classroom — the chalk box, the crayon box, a ball, the blackboard eraser, fluorescent light fixture; 2) in the home — juice cans, baby food cans, shoe box, the fridge, lipstick tube.	—tin cans —shoe boxes —ice cream cones —cookies —paper cups —spools —marbles —balls —bricks —sugar cubes —a set of geometric models (3-D)
2. **compare (similarities and differences)**	Objects can be compared and classified as to shape, thickness, colour and texture, and as to properties such as, "will slide" and "will roll", etc. Activities involving sorting objects from the "equipment box" are recommended.	
3. **classify objects by** a. shape b. size c. property	A "shape book" and/or a "shape day" provide interesting activities.	
B. 2-D (Plane) Shapes in the Environment The student should be able to: 1. **recognize 2-D shapes** — square — rectangle — circle — triangle 2. **compare 2-D shapes** 3. **classify 2-D shapes**	The analysis of three-dimensional (solid) shapes should lead to the discovery of two-dimensional (plane) shapes such as the square or rectangle from the box shape; the circle from the top of a can (cylinder) or cone; and the triangle from certain prisms and pyramids. Comparison and classification activities (as above) are recommended. Arouse awareness of 2-D shapes in the environment, e.g., road signs, flags, manhole covers, clock face, advertising signs (billboards), floor tiles, window panes.	—plane shapes — tiles —shapes constructed out of cardboard, plastic, wood, flannel —paper shapes for folding (symmetry) —attribute blocks (Logi-blocks) —playhouse in cardboard or wood (to discover plane shapes on houses)
4. **recognize 2-D shapes in the environment**		
5. **recognize symmetry in 2-D shapes**	Paper folding is a useful activity for investigating symmetry. NOTE: Geometry should not be treated as a unit in isolation, but should be integrated with other topics throughout the year.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
V. GRAPHING **A. Two Sets of Information** The student should be able to: — collect information and represent it: 1. concretely 2. pictorially	Graphs provide a valuable means of communication. They simplify information, observations and conclusions. Teachers should encourage children to interpret graphs orally. The teacher could write the title and a written statement given by the children or an appropriate experience chart could be constructed.	—shoes —blocks, coloured beads for stringing —cubes, counters, gum or candy wrappers —pictures from magazines, hockey player cards —gummed stickers
B. More Than Two Sets of Information The student should be able to: — interpret orally the outcome of the representation	Children might make up questions from the graphs for their peers to answer. Graphing experiences can grow out of topics initiated in other subject areas, such as social studies, science, health and stories from a reader.	
C. Progression in Graphing The student should be able to construct: 1. concrete graphs of real things, e.g., boys, girls 2. concrete bar graphs, 3-D shapes representing real things, e.g., blocks, boxes 3. pictographs	*Suggested topics (choose appropriate type of graph):* — keep attendance pictorially (cut-outs of boys and girls) — the graph shows a comparison of two sets — favourite — pet, colour, story in a section of a reader, cartoon, fairy tales, television program, chewing gum — how we come to school — colour of jackets worn to school — hair or eye colour — recording growth of a plant — types of homes — one-storey, apartment — weather chart, record of daily milk consumption	—cellulose coloured tape —strips of coloured paper —crayons, felt pens —graph paper

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VI. MEASUREMENT		
A. Linear Measurement	Measurement should be informal and active, and integrated as much as possible in daily school activities.	
1. Non-Standard The student should be able to: a. use a non-standard unit to measure the length of an object b. use a non-standard unit to compare the length of two objects (measuring)	Linear measurement requires continuous emphasis on activities involving estimating, measuring, comparing and recording. Actual measurements (non-standard then standard) should be recorded in various ways — verbally and on charts or graphs.	—string —ribbon
2. Standard — centimetre (cm) **— metre (m)** The student should be able to: a. use a standard unit to measure the length of an object	After children have had many experiences using non-standard units, they measure in centimetres: their feet, hands, thumbs, material in and on their desks, things nearby and things in the classroom. *Readiness* — discover 1 cm rod is $\frac{1}{10}$ of a 10 cm rod and $\frac{1}{10}$ may be expressed as 0.1	—10 or 20 cm rulers —orange Cuisenaire rods (10 cm) —white Cuisenaire rods (1 cm) —metre stick
b. use a standard unit to compare the length of two objects	A 10 to 20 centimetre ruler is helpful. The metre is introduced as the appropriate unit of measure for objects of greater length. The pupils estimate first and then measure to find out if the object is longer than, shorter than, or the same length as the metre.	
B. Readiness for Other Measuring The student should be able to: — gradually show an understanding of area, volume, capacity and mass in informal activities	Activities leading to the awareness of area, volume, capacity and mass are developed by using non-standard measures. *Crude comparisons* are made by using sand, water, etc., and also by using a balance scale to determine more than, less than, heavier, holds more sand, etc. No attempt is made to give numerical answers.	—small tiles or other area units —sand, marbles, water, balance scale —containers (plastic), pail

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Time **1. Division of a Day** The student should be able to:	NOTE: Developing the concept of time is not only learning to read time on a clock.	
a. relate an event to the appropriate part of the day b. name the parts of the day in sequence	Discussions on daily events which usually happen in the morning, noon, afternoon, evening, at night — When do we eat supper? — help the child to develop the concept of time. Charts could be made for each part of the day (preferably pictorial) depicting the events — they can later on be put together sequentially to form a day.	—pictures of daily events (children eating supper)
2. Days of the Week The student should be able to:		
a. name the days of the week b. name them in proper sequence	Discussions on the day of the week and/or special events on certain days help the children to become familiar with the names of days. For example, We have assembly on . . .; There is no school on . . .; My favourite television programs are on . . .	—calendars
c. relate an event to the appropriate day	Same activities as suggested in #1.	
d. begin to read a calendar	Check off the date on the calendar every day. Discuss yesterday, today and tomorrow.	
3. Months of the Year The student should be able to:		
a. name the months of the year b. relate important events to the right month	Develop a continuous chart or a graph combining birthdays as well as special events.	—pictures showing special events during the month (Christmas, Valentine's Day)
4. Telling Time The student should be able to:		
a. recognize the time on the clock as it relates to a specific event	Initially the children should be able to recognize the important times on the clock, e.g., 9 o'clock school begins, 12 o'clock lunch time. As they become familiar with number sequence, the development of time sequence to the hour is appropriate, e.g., 1 o'clock, 2 o'clock.	—plastic lids for clock faces —pie plates for clock faces
b. tell time to the hour	The children should be made aware of the many different kinds of clocks and actually compare the actual time lapse on two or more different clocks, e.g., wristwatch (non-digital), alarm clock, wall clock.	—clocks

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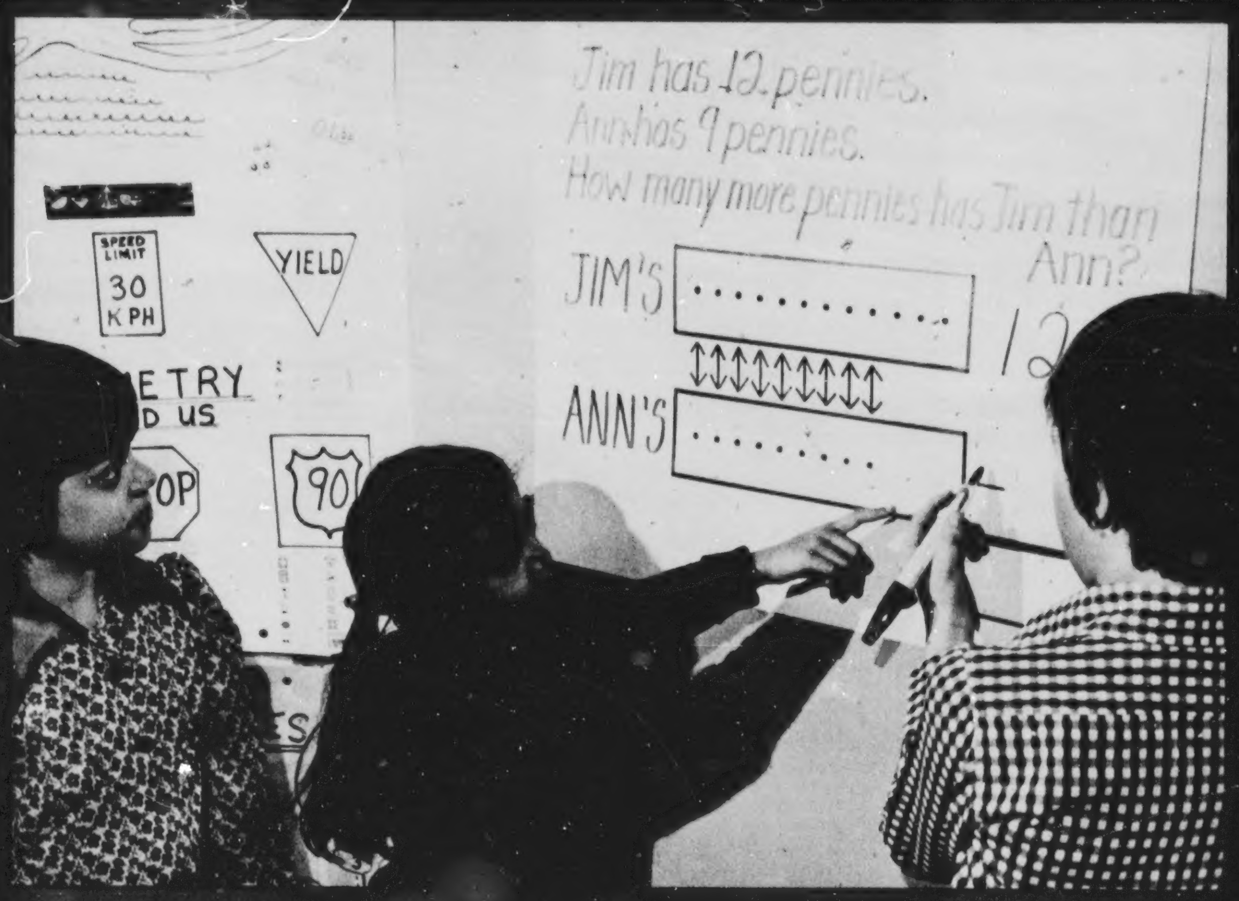
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Money **The student should be able to:** **1. identify and name 1¢, 5¢, 10¢, and 25¢ coins** **2. use 1¢ and 5¢ coins in real and play store experiences**	A play store offers many opportunities for learning experiences. Items in the store could be labelled and play money or real money could be used.	—store items — tickets with prices (1¢-5¢) —play money
VII. PROBLEM SOLVING (ORAL) **A. Concretely**	Problems of social value to six-year-old children should motivate them to find the solutions using the previously learned skill.	
The student should be able to: 1. represent the problem concretely 2. perform the action indicated in the problem 3. describe orally the action performed 4. answer the question in the problem	*Problem situations should arise every day.* They should be oral in nature and lend themselves to easy interpretation by the use of manipulative material. Oral interaction at this point is extremely important. Such questions as: "What did you have to begin with?"; "Then what happened?"; "What did you do?"; "What have you now?"; all help the child to understand the operation involved in the problem.	—pictures to discuss —concrete materials —magnetic board and material —flannelboard and material (bingo chips) —cash box —overhead projector and concrete material (bingo chips)
B. Pictorially The student should be able to: 1. represent the problem pictorially 2. perform the action indicated in the problem 3. describe orally the action performed	Children could illustrate simple problems by drawing. This could be a very valuable means of evaluating the child's understanding of the process involved.	
4. relate the written sentence to the oral statement 5. answer the question in the problem	The teacher should record the oral number sentence, given by the student.	

Concepts and Skills are indicated in Bold Face.


Jim has 12 pennies.
Ann has 9 pennies.
How many more pennies has Jim than Ann?
JIM'S
ANN'S
12
SPEED LIMIT
30
KPH
YIELD
ETRY
D US
OP
90

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. READINESS AND REVIEW ACTIVITIES (PREREQUISITE SKILLS)	Activities similar to those suggested in the grade 1 program may help the teacher find the children's level of readiness and consequently, help determine which children might benefit from re-teaching and which are ready to proceed with the grade 2 program.	
A. Counting The student should be able to:		
1. rote count 1-20 and beyond	1. rote counting (memorization of number sequence, minimum 1 - 20)	—songs and rhymes
2. enumerate (rational counting) 1-12 and beyond	2. rational counting (ability to determine how many things are in a set or group)	
B. Comparison of Sets The student should be able to:		
1. construct and identify sets of objects	1. Make sets according to attributes (characteristics). Encourage students to discuss why certain objects belong in certain sets.	—all kinds of objects — non-structured (environment) and structured — cubes, shapes —loops (surrounds) for sets —hula hoops
2. classify objects into sets according to colour, size, shape, etc.	2. Classifying things into sets and telling why they belong in the set.	
3. compare sets of objects as having more than, as many as, less than	3. Provide many experiences to compare sets by one-to-one correspondence.	
C. Addition and Subtraction The student should be able to:		
1. form a larger set by combining two or more sets (addition) **2. remove a subset from a given set (subtraction)** **3. find the difference between two sets by matching**	Illustrate story problems given by the teacher. These help the teacher determine whether the students understand the difference between addition and subtraction (concretely).	

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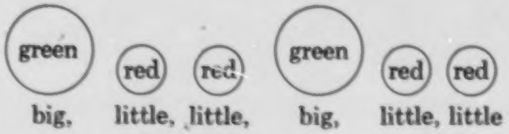
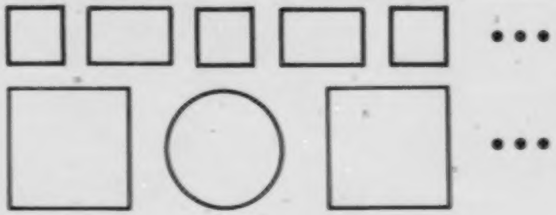
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. recall addition and subtraction facts	Check on mastery of addition and subtraction facts (1-10). It might take considerable time to review and/or re-teach number concepts up to number ten.	—number picture cards, fact cards, dice (games involving simple addition and subtraction questions)
II. **PATTERNS** **A. Concrete** The student should be able to: 1. recognize, reproduce, continue, and describe orally a concrete pattern	The students should have many opportunities to identify patterns constructed with concrete materials, to continue the pattern, and to describe it orally. They should have opportunity to reproduce given patterns correctly.  green red red green red red big, little, little, big, little, little	—felt boards —felt shapes —coloured counters —beads —bottle caps —parquetry blocks —coloured bingo chips —attribute blocks
2. reproduce an action pattern	Some examples of activities on action patterns — tap, tap, tap, clap, clap, tap, tap, tap, clap, clap; hop, step, step, hop, step, step, . . . A child might be selected to be "it" and give an action pattern for others to reproduce.	—tapes or records of sound patterns —percussion instruments —balls
B. Pictorial The student should be able to: — recognize, reproduce, continue, and describe a pictorial pattern	Tracing concrete patterns leads to a pictorial pattern. e.g.:, 	—attribute blocks for tracing —geometry shapes for tracing —variety of objects for tracing

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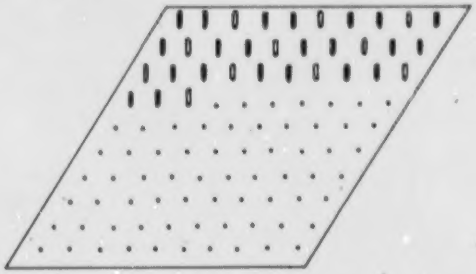
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Arrange pegs in pegboard in a certain pattern according to colour, for example: 2 red, 1 yellow, 2 red, 1 yellow.  Have the children complete the row, or the board, following the pattern. Experiences with the 100 pegboard will prepare the student to recognize numerical patterns on the 100 board or on the 100 chart at the grade 3 level.	—pegboard —pegs —geoboard —beads —ceiling tile —golf tees for pegs —blank transparency of 100 squares
C. Around Us **The student should be able to:** **1. identify patterns around us:** **a. man-made**	a. wallpaper, arrangements of floor tiles, linoleum or carpets should be examined for patterns	—floor tile —designs on china —wallpaper —fabric —Christmas wrap —pictures of townhouses —pictures of animals —pictures of insects —flowers —leaves —pictures of flower beds in parks
b. natural, repeating and symmetric	b. caterpillar, turtle, snake, zebra, leopard, tiger, butterfly, flowers, snowflakes, etc.	

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **create individual patterns in a variety of ways**	Music, art, social studies, physical education, and science provide many opportunities for discussion and creation of patterns. *Patterns in Music and Verse* Clap, tap or drum simple rhythms. Have the children listen and then repeat. Gradually increase the difficulty, combining claps and taps. Clap a familiar song. Ask pupils to listen and join in as soon as they recognize it. They will enjoy discovering the patterns in poems with strong rhythm. e.g., "Humpty-Dumpty" "Hokey-Pokey" "Old Macdonald"	—records or tapes of sound patterns —musical instruments (drum, triangle)
III. **STUDY OF WHOLE NUMBERS 0 TO 20** **A. Counting and Skip-Counting** The student should be able to:		
1. **count up to 20 and beyond** 2. **skip-count by 2's, 3's, 4's, 5's and 10's**	The student should have many opportunities to develop the skills of counting and skip-counting. Initially this will be done by using sets of objects, e.g., 16 objects. In how many different ways can you count 16 objects and which is the fastest way? By 1's — 1, 2, 3, 4 . . . 16 By 2's — 2, 4, 6, 8 . . . 16 By 3's — 3, 6, 9, 12, 15 and 1 more By 4's — 4, 8, 12, 16 By 5's — 5, 10, 15 and 1 more Throughout the year considerable time should be spent on counting experiences to help reinforce and maintain the counting skills.	—variety of objects

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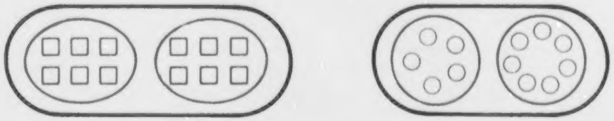
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Place Value (11-19) The student should be able to: 1. identify a number within 11-19 as being 10 +	The structure of these numbers is very basic. It can be effectively discovered by using appropriate material which clearly shows the group of ten and the ones left over. Use the suggested material and let the children make many groups of ten. The teacher could write a numeral, the student reproduces it concretely and names it.	—coffee stirrers, plastic ties or elastic bands —Dienes blocks —Cuisenaire rods (ones and tens) —Unifix cubes (on the 10 rack) —counting beads in rows of ten
2. read and write the numbers 11-19	The above activities prepare the students for reading and writing the numbers as well as enabling them to express the numbers as 10 + . . .	
3. order the numbers	The students should have many opportunities (oral and written) to arrange the numbers in proper sequence as well as to find the number before or after a given number.	
C. Whole Numbers 0 to 20 — Addition and Subtraction 1. **Addition** a. Combining Sets The student should be able to: — structure a set of objects into two sets	It is suggested that each number be studied individually and also as it is related to numbers previously studied. The following is an example of a suggested procedure on the number twelve: Addition — developing addition concepts and facts by using concrete material. Students should restructure 12 over and over into two sets.  Stress the most obvious way first: 10 + 2.	—blocks —rods —straws — tongue depressors —cardboard (manilla tag) cut-outs —beads —coins (pennies)

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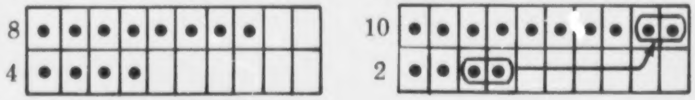
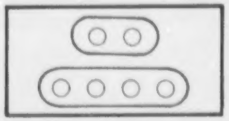
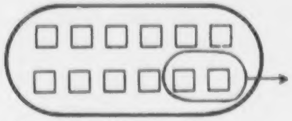
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
– use an oral addition number sentence	Children should be encouraged to discuss the various number combinations they have constructed, *tell* them to the teacher or to a pupil who records them on a chalkboard.	
– write the corresponding addition number sentence to a number combination	Children may now individually make as many combinations of the number as they can, using materials, and write the corresponding number sentence.	—individual number sentence cards —pictures (illustrating many items)
– give all the addition sentences for a given number	The teacher has drawn many sets on prepared sheets, the students are to combine the sets that make up a given number, e.g., 12. — Many number sentences are written, the students circle only those related to the given number. — Students select from a large collection of sentence cards only those related to a given number, or to match the model (picture).	—individual number sentence cards —pictures (illustrating many items) —sentence card to match the model (material)
– use the grouping by ten to solve an addition problem	When two sets are to be joined, removing part of one set and placing it in the other set, the sum will not change. The following grid and chips will help to illustrate the above principle. Each child should have the grid and the markers to be able to perform the operation. e.g., 8 + 4  becomes 10 + 2 = 12	—paper grid two rows of ten bingo chips
b. Commutative Property The student should be able to:		
– show that the sum does not change when the positions of the sets are reversed	The understanding of the commutative principle may be developed through the use of manipulative material and/or illustrations. Reverse position of the sets. e.g., 7 + 5 = 5 + 7	—counters and styrofoam cups, tin cans or other containers with removable numeral tickets on the outside

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. Property of Zero The student should be able to: – show that adding 0 to a number gives the same number	Children should have many opportunities to show and draw an empty set as it is related to an empty box, an empty purse, and as having no things in it. Consequently, joining an empty set to a given set gives you just the given set.	
d. Vertical and Horizontal Notation The student should be able to: – read, write and interpret vertical and horizontal notation	Vertical notation should be introduced. It is good procedure to use both horizontal and vertical notation simultaneously. Children should become aware that both notations express the same operation. The vertical notation can easily be illustrated with material by placing two sets vertically and making them correspond with the vertical position of the numerals. e.g.,  $\begin{array}{r} 2 \\ +\ 4 \\ \hline 6 \end{array}$	—metal board with magnetized chips or cardboard cut-outs —flannelboard and cut-outs and numerals
2. Subtraction a. Removal of a Subset The student should be able to: – remove a subset from a given set concretely and identify the remaining set – remove a subset from a given set pictorially and identify the remaining set	Subtraction can be shown by removing a subset from a given set, e.g., from a set of 12 objects remove two objects. 	—cubes, clips —blocks —buttons —felt cut-outs —magnetic board —overhead projector (using small objects on the projector) — excellent for review and oral problems

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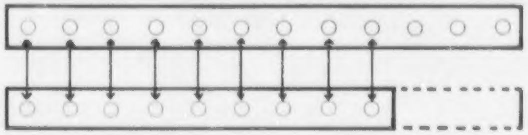
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. Difference between Sets **The student should be able to:** **— find the difference between 2 sets (one-to-one correspondence)**	Subtraction is comparing two sets. When children work in two pairs, they can readily compare their sets and should be encouraged to determine whether one set is more (larger) than the other, or less (smaller) than the other, and by how much. This interpretation of subtraction should initiate many oral problems related to everyday life experiences of the children. 	
c. Number Sentences The student should be able to: **— express orally and in writing a number sentence related to a subtraction problem**	Children should learn to express the relationship in the above diagram in as many ways as possible, both orally and in writing. Before introducing the symbols > and < , the students should have had many opportunities to express orally the relationship between 2 sets. Only then, should the symbols be introduced as the written way of expressing this relationship. $12 > 9$ — $9 < 12$ 12 is more than 9 — 9 is less than 12 $12 - 9 = 3$ $9 = 12 - 3$ $9 + 3 = 12$ $12 = 9 + 3$ $12 - 3 = 9$ $3 = 12 - 9$ $3 + 9 = 12$ $12 = 3 + 9$	
d. Inverse of Addition The student should be able to: — solve a subtraction sentence by finding the missing addend	When finding the difference between 2 sets concretely by comparison, the following question leads directly to missing addend sentences, e.g., 12 is more than 9 — how many more do we need to add to make 12? $9+\boxed{}=12$ $9+\boxed{3}=12$ $3+\boxed{9}=12$ $12-\boxed{3}=9$ $12-\boxed{9}=3$ It is good practice to combine as much as possible the two operations in *simple short problems.* This will help the children to assimilate the concepts of both operations as well as reinforce basic facts.	

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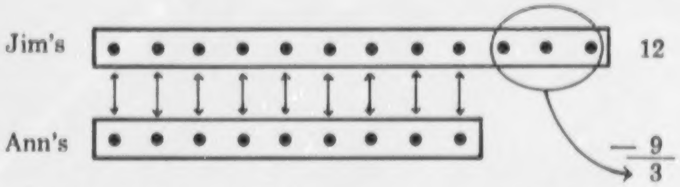
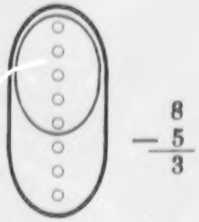
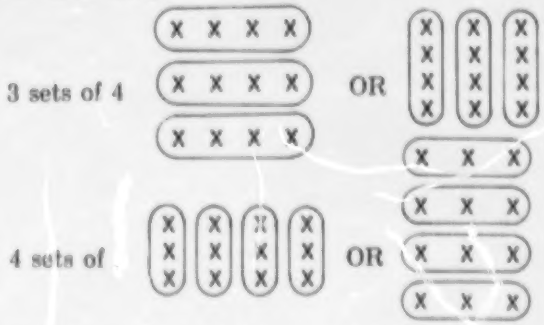
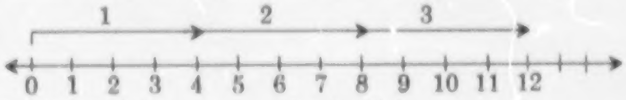
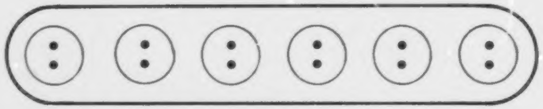
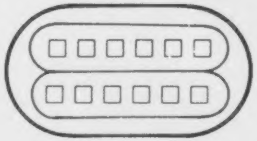
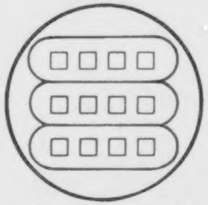
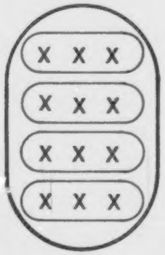
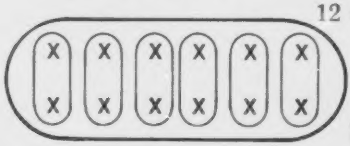
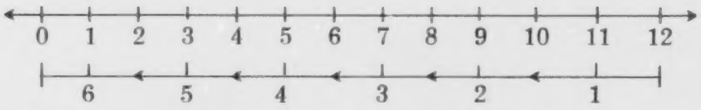
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
e. Vertical and Horizontal Notation The student should be able to: — read, write and interpret vertical and horizontal notation	Introducing the vertical notation in subtraction can best be achieved by the use of material and a story problem, e.g., 1. Jim has twelve pennies — Ann has 9 pennies. How many more pennies has Jim than Ann?  2. Jim has 8 Smarties. He eats 5. How many Smarties are left? 	
f. Property of Zero The student should be able to: — show that subtracting zero from a number does not change the number	Children should have many opportunities to show that removal of an empty set from a given set leaves them with the same set. (Set terminology not necessary for children.)	
3. Mastery of Addition and Subtraction Facts The student should be able to: — recall with increasing proficiency the addition and subtraction facts up to 20	Memorization of addition and subtraction facts can be promoted through various activities, games, exercises, and drills.	—interesting teacher-made games using dice —flashcards —playing cards —dice with numerals

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Multiplication and Division **1. Multiplication** **a. Combining Equivalent Sets** The student should be able to: – illustrate multiplication by joining equivalent sets concretely and identify the product	See grade 1 section for readiness activities. Building of equivalent sets, e.g., make 3 sets of two, 4 sets of two, 3 sets of four, etc. Explore the number 12 as having an exact number of equivalent sets (use material) — sets of 1, 2, 3, 4, 6, 12. Children should be encouraged to express their findings orally in many ways: 2 + 2 + 2 + 2 + 2 + 2 or six 2's, six sets of two.	—variety of small objects —rods, blocks, cubes, chips —buttons, cubes, beans —these objects can be grouped in sets, or in containers (egg cartons, trays with partitions) —pictures of equivalent sets
b. Commutative Property The student should be able to: – illustrate a multiplication problem using arrays and identify the product	Making arrays  as well as arrays of 6 twos and 2 sixes 12 ones and 1 twelve The application (the meaning) of the commutative principle is quite obvious here. 3 sets of 4 = 4 sets of 3 = 12.	—children can be used to make arrays (two rows of 6 children, etc.) — when the 2 rows turn a quarter turn, we have 6 rows of 2 —squared graph paper to make arrays —overhead projector with large grid transparency
c. Number Line The student should be able to: – illustrate a multiplication problem using a number line (repeated additions) and identify the product	Interpreting multiplication on a number line, e.g., 3 × 4.  3 jumps of 4 3 sets of 4	—floor number line —wall or board number line (cricket jumps) —centimetre ruler —hundred chart

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
— illustrate multiplication by skip-counting and identify the product	The students should be able to find the product of 3 sets of 4 by skip-counting, e.g., 4, 8, 12.	—repeated addition cards e.g., 4 + 4 + 4 = ☐
— use the symbol, ×, in writing a multiplication sentence	The child should be asked to construct 2 sets of three, 4 sets of three, 2 sets of six and to express the action orally and in writing, e.g., 3 + 3, 2 threes, etc. Introduction of the new symbol — 2 threes — 2 × 3 4 threes — 4 × 3 At this point the children should have many opportunities to construct equivalent sets, to say and to write the different ways of expressing their representations.  2 + 2 + 2 + 2 + 2 + 2 In the above example students select the right multiplication sentence which would indicate 6 sets of 2 as 6 × 2. The first numeral tells how many sets; the second, how many members in each set.	—multiplication cards e.g., 3 × 4 = ☐
d. Property of One — Identity Element **The student should be able to:** **— solve a multiplication problem using the identity principle (4 × 1 = 4)**	Children should have many opportunities to discover that one set of 4 gives you 4, 1 × 4 = 4, etc.	
e. Property of Zero in Multiplication **The student should be able to:** **— solve a multiplication problem using the property of zero, e.g., 3 × 0 = 0** 175	Children should have many opportunities to do activities such as the following: find three empty boxes. Label each box as having 0 items. Question — How many things are in each box? (Zero things.) How many things in the three boxes? 0 + 0 + 0 = 0 and 3 × 0 = 0	—variety of containers 176

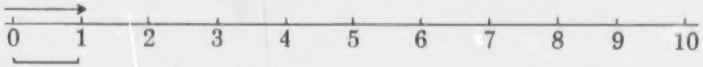
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **Division** **Separating a Set into Equivalent Sets** **The student should be able to:**		
— find a number of equivalent subsets in a given set (concretely)	The understanding of division is directly related to the understanding of multiplication as they are inverse operations. When a number is being explored, as was done previously with the number twelve, it is most logical to ask questions which lead directly to the concept of division and at the same time reinforce the understanding of multiplication. e.g., How many sets of six can you see in twelve? How many sixes in twelve? How many twos in twelve? Make twelve using sets of four. How many sets of four make twelve? All of these questions are related to division and multiplication.  12 = 2 sets of 6  12 = 3 sets of 4  12 = 4 sets of 3  12 = 6 sets of 2 It is essential that children have sharing experiences, e.g., 12 objects to be shared among 2, 3, 4 or 6 children.	—same material as for multiplication
— illustrate a division problem using a number line (repeated subtraction)	Interpret division on a number line (as repeated subtraction). e.g., in twelve, there are how many twos?  6 jumps of 2 in 12 or 12 = 6 twos There are 6 twos in 12.	

Concepts and Skills are indicated in Bold Face.

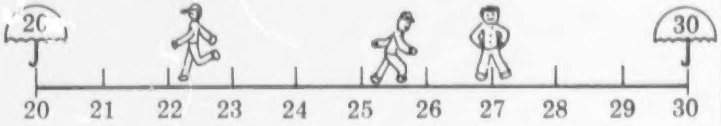
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	EXTENSION: Meaning of the division symbol — it is advisable to delay the introduction of the symbol, ÷, until children are thoroughly familiar with the concept of division. a. How many fours in twenty? b. Fours in twenty — how many? c. Twenty — how many fours? d. 20 ÷ 4 = ☐ — which reads, 20 — how many 4's?	
3. Mastery of Multiplication and Division Facts The student should be able to: — recall with reasonable speed and accuracy the multiplication facts with products up to 20 and the related division facts	Memorization of multiplication and division facts can be made interesting through various activities, challenging games, exercises and drills.	—teacher-made games using dice or answer cards —flashcards —playing cards —dice with numerals, operation symbols
IV. FRACTIONS **A. Unit Fractions of One Object** The student should be able to:	Reintroduce the concept of fractions through activities and experiences which should include *folding, cutting, sharing, comparing, and colouring.* (No symbols.)	—apples, gum (stick) —cardboard plates —paper geometric shapes such as a circle, square, rectangle
1. share an object equally with a friend or friends and name each part $\left(\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \text{of a set}\right)$ 2. identify that part as being $\frac{1}{2}$ or $\frac{1}{4}$	Find and then identify $\frac{1}{2}$ and $\frac{1}{4}$ of a concrete thing, e.g., children share an apple, a sheet of construction paper, etc. Check with the children to see if each child has the same amount. Discuss.	
B. Unit Fractions of a Set The student should be able to: — share a set of objects with a friend or friends and name each part $\left(\frac{1}{2}, \frac{1}{4}, \frac{1}{3}, \text{of a set}\right)$	Finding a fraction of a set is dividing the set into equal parts. $\frac{1}{2}$ of six candies — share equally with a friend $\frac{1}{4}$ of eight blocks — share equally among four friends $\frac{1}{3}$ of six cookies — share equally among three friends Verify by doing one-to-one correspondence.	—jelly beans —chips —cubes —rods —centicubes —10 cm ruler

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Unit Fraction $\frac{1}{10}$ **The student should be able to:** **– identify 1 cm as $\frac{1}{10}$ of a 10 cm strip or ruler**	Activities leading up to the introduction of $\frac{1}{10}$ as related to metric measure could be: a. Strip of paper folded into two equal pieces and named. Progress to equal pieces by folding once more. Then fold once more. What would we name one of the 4 equal pieces? One of the 8 equal pieces? b. Centimetre strip (10 cm long) folded on the lines. How many pieces? What would we name one of the 10 equal pieces?	—centimetre strips —Cuisenaire rods — 10 rod and 1 rod
V. DECIMALS (ONE PLACE) **The student should be able to:** **— rename $\frac{1}{10}$ as 0.1**	Simple decimal notation should now be introduced, mainly by reference to metric measure. 1 cm = $\frac{1}{10}$ of a 10 cm strip and can be rewritten as 1 cm = 0.1 of a 10 centimetre strip It is essential that the students can recognize 0.1 on the 10 cm strip as being equivalent to 1 cm.  This is one out of 10 or $\frac{1}{10}$ or 0.1 and is read as zero decimal one. EXTENSION: Construct, identify and name non-unit fractions, e.g., $\frac{3}{10}$, $\frac{4}{10}$.	—10 cm strips

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VI. **WHOLE NUMBERS UP TO 100** A. **Count, Read and Write Numerals** The student should be able to: 1. **count up to 100, read and write the numerals up to 100**	The ability to count up to 100 is quite basic at this level. Counting experiences can be set up through formal and informal activities: playground games (skipping and so on), finding the pages in a reader or other books, finding the sequence on the hundred chart or hundred board, etc. Connecting numbered data in the proper sequence to show a hidden picture is an appealing and useful activity. The sequence does not always have to cover the range 1-100, but could be split up, say from 21 to 41 or 29 to 61, so that the difficulty of moving to the next ten, e.g., 29-30 or 59-60, can be overcome. Searching for patterns on the hundred board often helps the student to overcome particular hurdles such as moving from 30 to 40, etc.	—popsicle sticks —coffee stirrers —Cuisenaire rods —plastic bread ties —metal rings pulled out from canned drinks can be tied in a bundle with a tie —Dienes blocks —number lines —hundred board (hooks and numeral tags) —individual hundred charts —pennies
2. **count by tens up to 100**	Applying counting experiences to interesting projects, such as counting all the pennies we saved for the Red Cross and stacking them in tens are excellent. The students might then be asked to tell and write how many pennies they have, e.g., I have 96 pennies — 9 tens and 6 ones.	—dimes —pennies
3. **locate a number in relation to other numbers**	Find a number on the hundred board, e.g., 53. Where could we find it—between 40 and 50? 50 and 60? Answer—between 50 and 60. Is it more than 50? How much more? Which number comes just before 53? Right after? Children could be given a set of numeral tickets (say 20) and place them as quickly as they can in the order from smaller to larger. When numbers are missing, the child could supply the missing numbers orally, or write the numerals on small slips of paper. A friend could then read his/her sequence and check.	—number line
B. **Expanded Notation** The student should be able to:		
1. **find the name for groups of objects by grouping in tens**	The understanding of expanded notation can be facilitated by selecting material that can be bundled, stacked, grouped in tens as required, where one bundle, one stack or one bunch of ten clearly represents ten ones. ////////// ////////// ////////// //////// 1 ten + 1 ten + 1 ten + 8 ones 3 tens and 8 ones = 38 10 + 10 + 10 + 8 = 38 30 + 8 = 38	—popsicle sticks —white beans —bean sticks: ten white beans pasted on a popsicle stick — each stick represents a ten

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **use expanded notation to rename any number from 11-100**	A number is given. The student finds the number of tens and ones, then records the results in expanded notation. 27 = 2 tens and 7 ones = 20 + 7	
C. Rounding Off to the Nearest Ten The student should be able to: — locate the position of a number relative to the nearest multiple of ten	When children learn the sequence of numbers between two consecutive tens, it can be discovered which numbers are closer to which ten. A number line helps to illustrate this, as well as some exciting teacher-made aids, e.g., run for cover as quickly as possible:  NOTE: It is common practice to move from 25 to 30, 35 to 40, etc. Rounding off is readiness for estimating. The above game should be most informal.	
D. Addition and Subtraction (Vertical Notation) **1. Column Addition (no regrouping)** The student should be able to:	Before introducing 2-digit column addition and subtraction, a brief review and discussion of the vertical notation of 1-digit addends with a sum less than 10 is advisable, and how it can be illustrated by placing the material vertically as well. *A good understanding of place value is a prerequisite.*	
a. solve an addition question containing a 2-digit and a 1-digit number — no regrouping	The introduction of the 2-digit addition can best be accomplished by first motivating the children to solve a problem, e.g., Jane bought candy for 24 cents, and a pencil for 5 cents. How much will she have to pay? Many children will solve this problem mentally, and count five more than 24. It is a good procedure to invite the children to show how they found the answer. (Use real money or play money to illustrate the problem.)	—Dienes blocks —popsicle sticks —straws —place value grid cards

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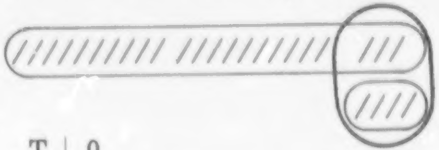
CONCEPTS, SKILLS AND OBJECTIVES

b. solve an addition question containing two multiples of ten

c. solve an addition question containing two 2-digit numbers

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Another example: 23 children came to a birthday party, then 4 more came. How many children are at the party?



Join ones — 3 ones and 4 ones

Join tens — 2 tens

T	0
2	3
+	4
2	7

Use concrete material for above.

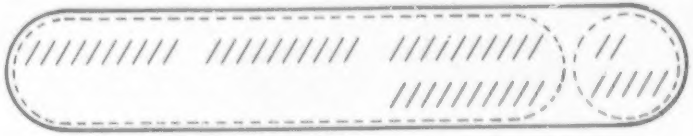
e.g.,

T	0
3	0
+4	0
7	0

A suitable problem should be given and represented with:

a. concrete material first (popsicle sticks)

e.g., 32 + 15



3 tens 2 ones
1 ten 5 ones

Join ones — 2 ones and 5 ones
Join tens — 3 tens and 1 ten
Total — 4 tens and 7 ones

b. pictorially

T	0
3	2
+1	5
4	7

SUGGESTED MATERIALS

- —individual addition question cards e.g., $\begin{array}{r}24\\+13\\\hline\end{array}$ $\begin{array}{r}42\\+31\\\hline\end{array}$ construct the question with material (to reinforce place value)
- —store items — price labels
- —pictures of items — price labels
- —make a classroom flier, children may choose two items to buy
- —cash register receipts

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

2. Subtraction (no regrouping)

The student should be able to:

a. solve a subtraction question taking a 1-digit number from a 2-digit number — no regrouping

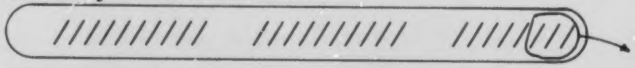
b. solve a subtraction question taking a 2-digit number from a 2-digit number — no regrouping

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

As can be seen from the preceding examples, individual place value grids are a great help. Children put the material on the grid and record the answer initially on grid paper, and later without the grid.

A store set up in the classroom can lead to many interesting situations where simple addition and subtraction problems can be created.

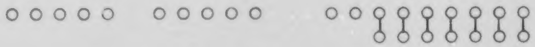
Problem 1: Jim had 28 hockey cards. He gave 3 to Ann. How many cards has Jim left?



2 tens 8 ones — remove 3 ones.
Now there are 2 tens and 5 ones.

	T	0
	2	8
—		3
	2	5

Problem 2: Ellen has 19 pennies. Mary has 7 pennies. How many more pennies does Ellen have?



The illustration shows that the problem is solved by matching.

	T	0
	1	9
—		7
	1	2

Same procedure as above.

e.g.,

	T	0
	5	0
—	3	0
	2	0

	T	0
	5	6
—	3	0
	2	6

	T	0
	5	6
—	3	2
	2	4

EXTENSION: Addition and subtraction with regrouping.

SUGGESTED MATERIALS

—place value grids
20 cm x 30 cm

T	0

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VII. GEOMETRY		
A. 3-D Shapes		
ball — sphere **can — cylinder** **box — cube and/or cuboid** **cone** **pyramid**		
The student should be able to:		
1. select 3-D shapes from the environment (or models) and compare them to find similarities and differences: — in size — in shape — in colour, texture and their use	Encourage continued awareness of 3-D shapes for roundness, size, colour, texture, their use, e.g., boxes for shoes, boxes for food. Some activities might lead to structuring small buildings by combining two or more shapes (the box shape and cone, pyramid or cylinder could look like a building).	—variety of boxes, containers, spools, toys —a set of geometric solids (models) —attribute blocks (Logi-blocks) for sorting, classifying, differences, similarities and games —envelope per child with cut-outs (geometric) of construction paper
2. classify 3-D objects according to the attributes mentioned above	Using concrete materials, the students will discover characteristics of various 3-D shapes and classify them according to various attributes. Make 3-D mobiles in art.	
B. 2-D Shapes		
— square **— rectangle** **— circle** **— triangle**		
The student should be able to:		
1. compare 2-D shapes for: a. similarities b. differences	NOTE: From a 3-D shape (i.e., milk carton) identify 2-D shapes and then slit along the vertical edges and open up to form a series of 2-D shapes (nets) — this net should be analyzed for 2-D shapes that are alike or different — elicit from the students in what way the shapes are different.	—deck of cards with names of shapes or pictures of shapes different in size, colour, and position, to be classified

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **identify 2-D shapes**	Re: number of faces, edges, corners.	—cut-outs of shapes —geoboards
3. **classify for specific attributes** 4. **find and name 2-D shapes in the environment**	A variety of "hands-on" experiences will help the students to recognize similar and different shapes. They learn to describe these similarities and differences and consequently, will identify the 2-D shapes by name. Students will become increasingly aware of 2-D shapes in the environment, e.g., road signs, flags, tiles, mirrors, window panes, door frames, desk tops, etc. From a picture page of buildings identify 3-D and 2-D shapes. Make 2-D mobiles.	
C. Symmetry The student should be able to:		
— **recognize symmetry in 2-D shapes**	Paper folding is a useful activity. Investigate symmetry in the environment, e.g., butterfly, bird colouring and shape, flowers, trees, buildings, designs (wallpaper), etc.	—paper shapes for folding
	Note on terminology: Although the teacher uses the correct terminology together with the child's vocabulary, it would not be wise to force terminology on the children just for memorization. The children will use the terminology when they feel confident about the association of the word and the shape.	
	Note on integration of measurement with geometry, graphing, etc., and other disciplines: Correlate measuring experiences with geometry activities, e.g., measure one side of the square, then measure another side (use string). Later, how long is each side in cm? Trace shape to make designs and patterns. Making a "shape" booklet: "My Favourite Shape" could be developed into an experience chart or could be an excellent topic for graphing. Squared paper and geoboards can lead to many discoveries about shapes, paths around them (perimeter), locating a dot (point) inside or outside a shape, etc.	—string —centimetre ruler — tape measure —graph paper —geoboard

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VIII. MEASUREMENT	IMPORTANT NOTE: It is very important for children to *estimate first* when doing activities related to measurement. It is also important to record measurements. The unit for measuring should possess the quality of the property which is being measured, e.g., a linear unit for length, a unit that has area, or an area unit for area.	
A. Linear Measurement **— non-standard measure** **— standard measure** **— m** **— cm** The student should be able to:		
1. demonstrate simple linear measurement with non-standard units	The same informal approach that was used in grade 1 should be used, and experiences and activities should be continued. Some non-standard units might be blocks, paper clips, pencils, hands, etc. Measurements should be recorded in various ways, e.g., verbally, on charts or graphs.	—blocks —paper clips —erasers —pencils
2. demonstrate simple linear measurement with the metre stick and centimetre ruler	The units used should be appropriate, e.g., measure the length of the room with the metre stick and the length of a book with a 20 centimetre ruler.	—string (1 m lengths) —metre stick —tapes —rulers (20 cm) —Cuisenaire rods
3. use and compare measures of length (1 m = 100 cm)	A great deal of practice with multiples of ten would lead to the understanding of the relationship between metres and centimetres.	
B. Readiness for Area The student should be able to:		
— demonstrate the concept of area by using non-standard units	Informal readiness activities include using objects of non-standard sizes to cover up a two-dimensional space. Estimating is valuable in developing the concept of area — how many hands will cover the desk? Check by doing.	—squares —tiles —hands —various 2-D shapes

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Readiness for Volume **The student should be able to:** **— demonstrate the concept of volume by using non-standard units**	Activities leading to the awareness of volume are developed by using non-standard measures. Containers can be filled with blocks and cubes to find how many are needed. Estimating and checking help to develop the concept of volume.	—blocks —cubes
D. Capacity — litre, half-litre **The student should be able to:** **— use and compare measures of capacity (litre and half-litre)**	Capacity measurement with non-standard units should precede the introduction of the litre. Many experiences of measuring capacity by reference to the litre should be experienced. Pupils learn to order containers by their capacity in litres. The half-litre should be recognized.	—various containers (milk cartons, plastic bottles, etc.) —litre containers —sand —sawdust —grain —rice —water
E. Mass **The student should be able to:** **— use the kilogram in measuring mass**	Children should use various non-standard units before being introduced to the kilogram, e.g., plastic bags containing sand, marbles, beans, etc. Children enjoy weighing themselves (measuring mass). Use the kilogram as the unit of measure. Results should be recorded or graphed. *Further activities in measuring mass could include the following:* 1. Kilogram weights may be used on the balance scale to compare the mass of various objects. These kilogram weights may be made of plasticine, stone, sand, rice, etc. Many experiences will help the children to become more familiar with this unit of measure. 2. Weigh various familiar objects to reinforce the concept of mass using the kilogram as the unit of measure.	—marbles —beans —balance scale —compression scale in metric units —spring scale —kilogram weights —plasticine

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
F. Money		
The student should be able to:		
1. identify and name coins and the one dollar bill 2. solve money problems involving addition and subtraction	NOTE: Addition problems should not involve sums greater than 99¢. Subtraction problems should not involve amounts greater than 99¢. A play store and visits to a real store would provide meaningful experiences — these could include finding the cost of an item , comparing the cost of two items, deciding whether the student would have enough money to buy a particular item, etc.	—real money —play money —price tags —newspaper ads —store items
G. Time		
1. Divisions of a Day (Morning, Noon, Afternoon, Evening, Night)		
The student should be able to:		
a. relate an event to the appropriate part of the day b. name the parts of the day in sequence	Interesting discussions of activities performed or things that happen in the various times of the day can reinforce the larger units of time. Charts depicting events which happen in the morning, afternoon, etc., could be made, e.g., a set of sentences describing events can be placed on the chart under the proper heading or put in the order in which they occurred in time	—picture cut-outs of specific events —word sentence cards relating to specific events or to the pictures
2. Days of the Week		
The student should be able to:		
a. name the days of the week in proper sequence		
b. relate events to appropriate days	Discussions — What happens on Mondays? Class goes to the library, first day of the school week, a certain television program, etc.	
c. read the calendar	This should be part of a daily activity.	
d. classify events as they happened yesterday and today or as planned for tomorrow	The concept of yesterday, today and tomorrow is a difficult one to develop. It is best approached by relating it to identifiable events. See details of suggested procedure in kindergarten and grade 1 sections.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. Months of the Year **The student should be able to:**		
a. name the months in proper sequence and relate important events to the right month	Elaborate on special events (birthdays, holidays, etc.) during the year as they occur.	
b. recall the name of the month before and/or after the present month	It is suggested that a birthday graph (bar or pictorial) be constructed by the children to illustrate the months of the year in sequence.	
c. give the name and the ordinal number of the month of his/her birth, or of any given month	This is readiness for writing the date according to the SI system. Refer to the graph mentioned above to find the ordinal number for each month.	
4. Telling Time **The student should be able to:**		
— tell time by the hour, the half-hour, the quarter-hour	Children are interested in time as it relates to their activities. They could record their day, e.g., I got up at School begins at Lunch time is at Back to school at Recess at Home again at The children could put the hands on the clocks to show the times of the various events. "Favourite Television Programs" is an interesting topic. The pupils could write the time, mark it on a clock face and then perhaps write a good sentence about the program.	—clock faces
H. Temperature **The student should be able to:**		
— read and interpret the Celsius thermometer	It is essential that children have hands-on activities in science related to: cold, hot, warm, and locate and identify positions on the thermometer. (See science program.) They should use a model thermometer to illustrate their estimation of a temperature, then verify and compare with the real thermometer.	—model of Celsius thermometer —Celsius thermometer

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	After the children can count up to 100, they can easily read the Celsius thermometer, as it is really another number line. Discussions on the weather will include the relationship of the temperature to our comfort.	
IX. GRAPHING **The student should be able to:** **— record data, construct, interpret and give a title to:**	Graphing should be initiated and integrated in other subject areas because graphs are a very useful means of recording information in a brief, meaningful way. Graphing can be done any time of the school year, in fact, it might make for an interesting beginning of the school year.	
1. a concrete graph	Simple concrete graph, e.g., boys and girls in the room are put in two rows. How many are there of each? Magnets — one side of graph: things that are attracted; other side of graph: things that are *not* attracted. How many are in each column?	
2. a concrete bar graph	Objects representing real things, e.g., social studies topic on foods — after discussion on food, care of body, etc., children indicate their choice of favourite food by using a coloured cube, a certain colour for a certain group. On the edge of a table, tape a picture of each kind of food (restrict choice to about four food groups). The children will stack the cubes on the table above the picture of their favourite food. This now is a concrete bar graph. Discuss the choices, how many more apples than carrots, etc.	—blocks, cubes —Unifix cubes —beads for stringing
3. a pictograph	Pictographs lead to interesting discussions about number relations, e.g., use a large calendar to record the weather daily. (Construct several cards with pictures of a sun, a cloud, raindrops, snowflakes. Every day a card is pasted over the date.) At the end of the month, the calender is cut up and cards classified and pasted on a graph. Have a discussion on the number of sunny days, the most, the least, etc.	—children's own pictorial representation of topic discussed —pictures of all kinds of things related to the topic
	NOTE: Quite often an experience chart may accompany the graph as a correlated language arts activity. For suggested topics see grade 5 section.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
X. PROBLEM SOLVING **A. Oral Problems** **The student should be able to:** **— solve oral problems**	Problem-solving situations may occur every day in the classroom. They do not necessarily have to be restricted to the mathematics period. Social studies, science, and language arts can initiate many interesting problem-solving situations. The following sequence may be helpful:	
	1. Most problems in the first months of the year should be oral. They could involve analyzing a picture. The teacher should encourage the children to talk about the picture and should direct questions which will require an answer arrived at by a mathematical process, e.g., from a picture of a family in the living room, discussion might lead to such questions as: How many grown-ups are there?; How many children are there?; How many people are there in the room? The teacher then records on the board, $3+2=5$, and the answer is discussed: there are 5 people in the room. The answer is checked by looking at the picture and finding that 3 children and 2 grown-ups are 5 people. Select a picture that can lead to several problems.	—interesting pictures —store set up and toy money —representative materials used for teaching of operations: counters and surrounds, flannelboard and material, magnetic board and material, number line, chalkboard diagrams
	2. An oral problem could be given and the children asked to illustrate it on the flannelboard, or the magnetic board, and find a mathematical sentence to correspond with the problem solving.	
	3. Oral problems can now be illustrated individually by using representative material and by expressing the mathematical sentence orally and in writing.	
	4. The teacher may write a mathematical sentence on the blackboard and ask the children to make up a word problem about the sentence.	
	NOTE: Wherever possible, in problem-solving situations, a student should: a. estimate the answer; b. solve the problem; and c. compare the solution with the estimated answer.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Written Problems The student should be able to: — solve written problems	Written problems should only be introduced when children have acquired sufficient skills in reading and in previous oral problem solving. Written problems should be brief and, as much as possible, related to real-life experiences. The following steps are suggested: 1. The teacher reads the problem with the children. 2. Discuss the situation to find out what we know and what we have to find out. 3. What do we do to find the answer? 4. Check the solution (if necessary with representative material). 5. Children are encouraged to try to solve a similar problem independently. Developing a positive attitude toward problem solving is as essential as is the ability to use the mathematical skills to solve problems. This is best developed through small group interaction and a good choice of activities. Children should be encouraged to demonstrate, in their own way, how they arrived at the solution. Thus, they might discover that more than one number sentence can be used to arrive at the same solution to a problem. This also helps the teacher to see when a student may be having difficulty.	

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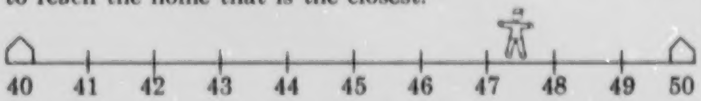
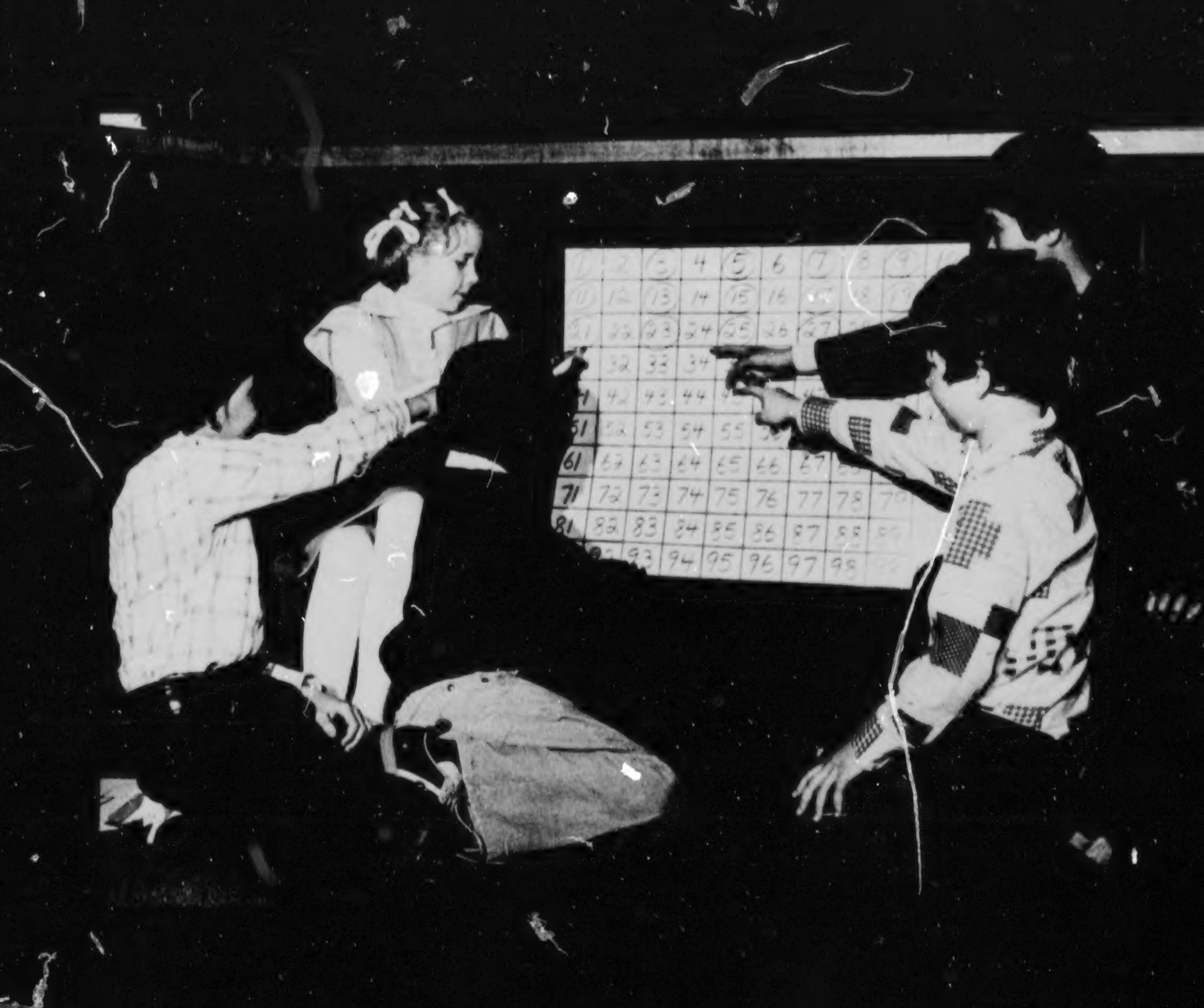
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. READING AND REVIEW ACTIVITIES (PREREQUISITE SKILLS)	*Suggested Introductory Activity:* In order to motivate the children at the beginning of the term it is recommended that a project be initiated involving geometry and/or graphing. Creative activities help children to gain confidence and enjoyment in learning mathematics.	
A. Counting	Concrete materials are recommended for the introduction and understanding of concepts.	—popsicle sticks —straws —sticks —Dienes blocks —ten trays (from egg cartons) —counters —money —hundred chart —place value grid
The student should be able to:		
1. count up to 100 by 1's, 5's, and 10's	In counting by fives and tens, use of the hundred chart helps children to see the sequence and pattern.	
2. read and write numerals up to 100	Review reading and writing of numerals up to 100 through various activities and games.	
B. Basic Facts		
The student should be able to:		
— recall basic facts and solve problems involving the four operations	At the beginning of the year, simple problem-solving situations will indicate whether the student knows the meaning of the operations and can find the answers with accuracy.	
C. Place Value		
The student should be able to:		
— identify how many tens and ones are represented by any numeral up to 99		

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Rounding Off **The student should be able to:** **— round off to the nearest 10**	Certain games will help students understand the concept of rounding off, e.g., "Home Free", where homes are located at consecutive multiples of ten and the child inbetween tries to reach the home that is the closest.  NOTE: It is common practice to move from 25 to 30, 35 to 40, etc.	
II. STUDY OF WHOLE NUMBERS 0 TO 100 **A. Addition and Subtraction** **1. Basic Facts** **The student should be able to:** **— recall with increasing proficiency, the addition and subtraction facts up to 20**	Continue work on mastering and maintaining addition and subtraction facts up to 20. It may be necessary to re-teach addition and subtraction concepts. As subtraction is the inverse of addition, it is most appropriate that both concepts be developed simultaneously. The use of material is highly recommended where a child can join sets for addition or remove a subset for subtraction.	
2. Column Addition of Multiples of Ten **The student should be able to:** **— solve an addition question containing multiples of 10**	Column addition of multiples of 10 is a necessary skill in order to proceed to the addition of 2-digit numbers.	—popsicle sticks and other material grouped in tens —Dienes blocks —Cuisenaire rods —hundred chart



CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. Property of Zero **The student should be able to:** **— show that adding zero to a number or subtracting zero from a number does not change the number**	The property of zero in addition and subtraction should be reviewed and applied in column addition where the zero is in the units column. Story problems involving only items costing 10¢ or multiples of 10 can easily be understood by the children. The bill could be written in a column addition problem or a subtraction problem.	
4. Addition **a. No Regrouping** **The student should be able to:** **— solve a 2-digit column addition problem — 2 addends, no regrouping**	When introducing 2-digit column addition the use of appropriate material is essential so that children can experience joining the ones and joining the tens, giving a new number. The following is an example of a progression of steps in the teaching of 2-digit column addition, e.g., 24 + 13. — Use material to represent groups of tens and ones which could be placed on a place value grid. — Join the sets. — Record the answer in the place value grid. — Proceed to a more abstact method, e.g., 34 + 23. Rename 34 as 3 tens 4 ones Rename 23 as 2 tens 3 ones 5 tens 7 ones = 57 $\begin{array}{r\|l} T & O \\ \hline 3 & 4 \\ +2 & 3 \\ \hline 5 & 7 \end{array}$ $\quad \begin{array}{r} 34 \\ +23 \\ \hline 57 \end{array}$	
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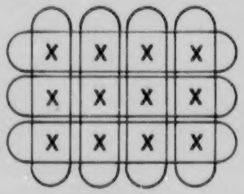
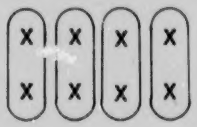
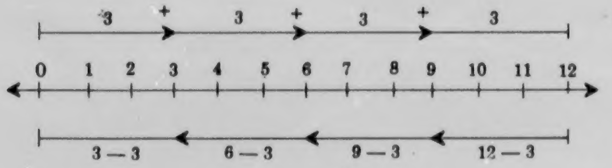
CONCEPTS, SKILLS AND OBJECTIVES	**TEACHER'S NOTES AND SUGGESTED ACTIVITIES**	**SUGGESTED MATERIALS**
b. With Regrouping **The student should be able to:**		
i. rename a number in many ways	Renaming a number is preparation for regrouping. A number has many names, e.g., the number 6 can be thought of as 3 + 3, 1 + 5, 7 — 1, 1 + 1 + 1 + 1 + 1 + 1, 4 + 2, 6 + 0, etc. Children may be challenged to find as many names as they can (oral and written) for a number. This will help children to see and understand number relationships and to memorize number facts. *Two-digit numbers can be renamed in a special way,* e.g., 24 = 20 + 4, 24 = 10 + 14. This should be experienced by the students using materials. The above form of regrouping (24 = 10 + 14) will be applied particularly in subtraction with regrouping.	—Dienes blocks —popsicle sticks —straws (bundles of ten)
ii. solve a 2-digit column addition problem — 2 addends	Before dealing with column addition with regrouping, it would be advisable to review addition of two 1-digit numbers with a sum of 10 or more so that the children will understand that a group of ten has been formed. This could be illustrated with material, e.g., 5 ones and 7 ones give you 1 ten and 2 ones or 12. e.g., $\begin{array}{lll} 15+7 \longrightarrow & 1 \text{ ten} & 5 \text{ ones} \\ + & & 7 \text{ ones} \\ \cline{2-3} & 1 \text{ ten} & 12 \text{ ones} \\ & 2 \text{ tens} & 2 \text{ ones} = 22 \end{array}$ $\begin{array}{rc\|c} & T & O \\ \cline{2-3} & 1 & 5 \\ + & & 7 \\ \cline{2-3} & 1 & 2 \\ & 1 & \\ \cline{2-3} & 2 & 2 \end{array}$ $\begin{array}{r} 15 \\ +\ 7 \\ \hline 22 \end{array}$ NOTE: The above is a teaching procedure and some children may not need all the steps. The teacher must use his/her own judgement.	
iii. solve a 2-digit column addition problem with more than two addends	The sum should not be above 100.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. Subtraction **No Regrouping and Regrouping** **The student should be able to:** **— solve a problem involving subtraction without regrouping and with regrouping**	Before going into subtraction with regrouping, children should have had many opportunities to rename a number in the following way, e.g., 34 = 3 tens + 4 ones = 2 tens + 14 ones When using material to illustrate this, a child should be able to make an exchange of 1 ten for 10 ones. $34 - 26 \longrightarrow \begin{array}{r} 3 \text{ tens } 4 \text{ ones} \\ \underline{-2 \text{ tens } 6 \text{ ones}} \end{array} \longrightarrow \begin{array}{r} 2 \text{ tens } 14 \text{ ones} \\ \underline{-2 \text{ tens } 6 \text{ ones}} \\ 8 \text{ ones} \\ = 8 \end{array}$ $\begin{array}{c\|c} T & O \\ \hline 3 & 4 \\ -2 & 6 \\ \hline & \end{array} \quad \begin{array}{c\|c} T & O \\ \hline 2 & 14 \\ -2 & 6 \\ \hline & 8 \end{array} \quad \begin{array}{r} 34 \\ -26 \\ \hline 8 \end{array}$	—Dienes blocks —Cuisenaire rods —bundles of tens and ones —abacus —dimes and pennies —hundred chart —number line
B. Multiplication and Division **1. Concrete** **The student should be able to:** **— illustrate multiplication and division problems by forming equivalent sets to find the solutions**	The concept of multiplication should be reintroduced by the use of material arranged in equivalent sets. The sets are counted so that 5 × 4 is interpreted as 5 sets having 4 elements each or 4 + 4 + 4 + 4 + 4 = 20. The solution was arrived at through repeated addition, but can be expressed in a shorter way orally, as well as in writing, 5 × 4 = 20. *As division is the inverse of multiplication it is most appropriate that both concepts be developed simultaneously.* When using material to develop multiplication many questions asked are actually division questions, e.g., how many sets of 4 are there in 20? The written form would be 20 ÷ 4 or $4\overline{)20}$.	—various counters —cubes —surrounds for sets —squared paper —overhead projector —flannelboard —magnetic board with magnetic materials —button cards —hundred chart —Cuisenaire rods

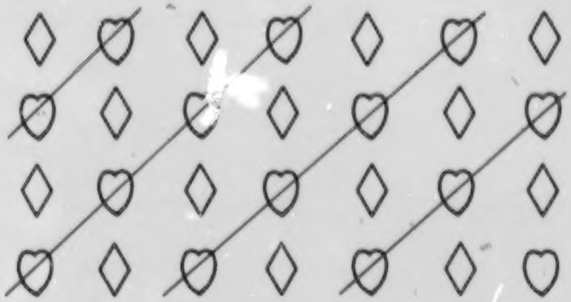
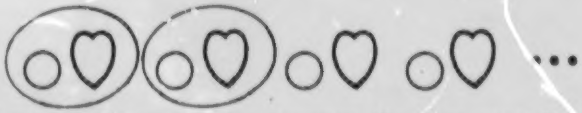
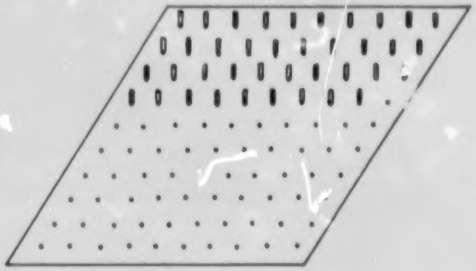
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Pictorial The student should be able to: — illustrate multiplication and division problems by making arrays to find the solutions	NOTE: *The division symbol is being introduced here for the first time.* Arrays can be used to illustrate multiplication and division. An array illustrates very effectively the application of the commutative principle in multiplication.  3×4 Commutative Principle $3 \times 4 = 4 \times 3 = 12$ This is readiness for finding factors of a product.  8 contains 4 sets of 2 $8 \div 2 = 4$ $8 = 4 \times 2$	—cards prepared to illustrate arrays
3. Number Line The student should be able to: — illustrate multiplication and division problems on the number line (repeated addition and repeated subtraction) and find the solutions	Multiplication and division can be illustrated on the number line, e.g., 4×3, $12 \div 3$.  3 + 3 + 3 + 3 0 1 2 3 4 5 6 7 8 9 10 11 12 3 — 3 6 — 3 9 — 3 12 — 3	—number lines
4. Property of One The student should be able to: — illustrate that multiplying or dividing a number by 1 does not change the number	To make children aware of the property of one in multiplication they should be asked to construct, e.g., five sets of one, nine sets of one, etc. Discussions of their results — $5 \times 1 = 5$, $9 \times 1 = 9$, $4 \times 1 = 4$, will lead the children to the discovery of the special property of one. Considering division as the inverse operation of multiplication, $5 \times 1 = 5$ becomes $5 \div 1 = 5$, thus illustrating that division by one does not change the number.	

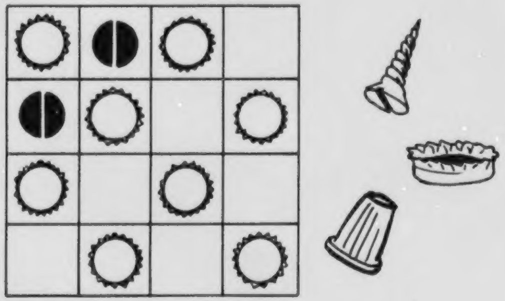
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Further activities showing one set of 5, one set of 9, etc., illustrate this property of one as well as the commutative principle. (It is not necessary to introduce the terminology — identity element.)	
5. **Property of Zero in Multiplication** **The student should be able to:**		
a. **illustrate the product of a number and 0 as being 0**	Empty sets could be illustrated by making surrounds or using empty containers — with no elements in the set, e.g., place 5 empty egg cartons on the table — How many eggs are there in 5 empty cartons? The number sentence can be written as $5 \times 0 = 0$.	—empty containers
b. **apply the property of 0 in multiplication**	The students should experience numerous situations to illustrate this concept.	
6. **Use of Product Grid** **The student should be able to:**		
a. **locate and explain multiplication facts up to 10 × 10 and the division facts up to 100 ÷ 10 from a product chart**	Students should be involved in activities which help them discover the products up to 10 × 10. Showing products on the hundred board will help children discover the patterns.	—100 product chart with numerals —100 product chart without numerals —games — commercial and teacher-made —dice —flashcards —multiplication wheel —division wheel —Cuisenaire rods —magnetic board

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. demonstrate mastery of multiplication and division facts up to 40	*Mastery of multiplication and division facts up to number 40 is expected by the end of the year.* Maintenance and mastery of the above skills can only be achieved through continuous activities and review throughout the year. Many games such as "Multo" and "Facto" (patterned after bingo games) are a good incentive for memorizing these facts.	
III. NUMBER THEORY		
A. Patterns	In K-2, students have begun the identification of patterns in the world around them: pattern of sound, of objects, of pictures, of actions. Students have had opportunities to represent given patterns in a variety of ways. As the students become more mature, the type of patterns they will be able to recognize and continue will become more complex.	
1. Concrete The student should be able to:		
— identify, reproduce, and describe concrete patterns	Review concrete patterns by constructing and describing patterns. e.g., chair, chair, desk, chair, chair, desk, . . .	—variety of concrete objects
2. Pictorial The student should be able to:		
a. identify, reproduce, and describe a pictorial pattern	Pictorial patterns should now be used more extensively.	—collections of a variety of pictures

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Find a simple pattern on wallpaper, wrapping paper, fabrics, etc. e.g., Have the students discuss different pattern repeats. a.  b. 	—wallpaper —prepared designs —sample of arborite —samples of tiles
b. **construct, complete, and describe patterns in the one hundred pegboard**	Using two colours of pegs, arrange the pegs according to a specific pattern — 2 yellow, 1 red — continue the pattern.  Many more patterns should be made. After continuing the pattern until a few rows are completed, the students should be able to detect a special pattern for the red pegs and might predict where the other red pegs will be located. NOTE: This is readiness for finding patterns on the hundred board.	—pegboard —pegs —geoboards —coloured beads —ceiling tile —golf tees

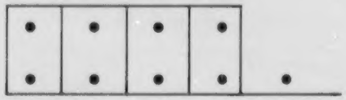
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. create and detect or recognize patterns	Student should experiment making patterns in other disciplines. e.g., a. *Art* — print-making using potato, cork, vegetable cuts, etc., to make designs with repeating patterns. *Wrapping Paper for Christmas or Mother's Day* Fold a large sheet of newsprint into 16 squares. i. Choose two objects such as bottle caps, toothpaste tops, etc., and stamp a pattern by dipping the objects into thick paint and pressing in alternate squares.  ii. Cut 2 different shapes from paper and paste in alternate squares. iii. Paste gummed shapes, seals, stars, etc., in alternate squares. iv. Cut 2 shapes and trace around each in alternate squares. Suggest more complicated patterns by using 3 or more shapes, and several colours.	—bottle caps —thimbles —screws —vegetable cuts —corks —gummed shapes —elbow macaroni

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. *Social Studies* — examine different ethnic handicraft for repeating designs.	—decorated Easter eggs —embroideries —pottery —weaving —buildings
	c. *Music* — students should create rhythmic patterns by using hands, percussion instruments, etc. d. *Science* — students should explore the natural environment for patterns, e.g., animal world, plant world.	—drums —triangles —sticks —bells —tapes or records
3. Number Patterns **The student should be able to:** **— recognize patterns for even and odd numbers on the 100 chart**	*100 Chart*	—transparency of a 100 chart —bingo chips (coloured, translucent) —duplicated 100 chart —overlays to show patterns on the hundred chart

100 Chart

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Colour in every second square on the 100 chart. The students should be able to detect the location of the even numbers and of the odd numbers, and detect the patterns of each group. Encourage investigation and discussion of other patterns on the 100 chart. Counting by 5's, mark the numbers with an X. What is noticed about the pattern? Counting by 2's, 3's, 4's, and 5's on the 100 chart could be examined for specific patterns. NOTE: A transparency of the 100 chart projected on the chalkboard is a most efficient aid.	
B. Even and Odd Numbers **The student should be able to:** **— illustrate even numbers and odd numbers up to 20 by showing groups of two**	An interesting way of illustrating the concept of even and odd numbers is by representing the sequence of numbers 1 to 10 by using cubes, bingo chips, small cut-out squares.  The children should be made aware that some numbers contain exact groups of two and others have one left over. When the shapes are classified in this manner, they find out that 2, 4, 6, 8 and 10 have exact arrays of two and are called even numbers. Also, 1, 3, 5, 7 and 9 do not have exact groups of two and are called odd. The odd shapes are made up of sets of 2 plus one extra. Students should become quite competent in counting by 2's starting at 2 and starting at 1.	—manilla tag squares —cubes —bingo chips —graph paper (squared)

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Introduction to Factors **The student should be able to:**		
— identify two factors for each product up to 40	Factors should be correlated with our study of multiplication and division. When the children can write and interpret a multiplication sentence with ease, e.g., 5 × 4 = 20, then 5 and 4 can be named as factors of 20. Then all the multiplication sentences that make 20 could be explored and all factors of 20 could be found. The factors of 20 are 1, 2, 4, 5, 10, and 20, because 20 = 1 × 20, 20 = 2 × 10, 20 = 4 × 5. The children will discover after many examples that 1 is a factor of every number.	—multiplication fact cards —division fact cards
D. Readiness for Prime and Composite Numbers The student should be able to discover numbers which have:		
1. 2 factors	When the children have mastered multiplication and division facts they could sort the numbers into two groups. One group would consist of numbers having only two factors — namely 1 and the number itself, e.g., 7 = 1 × 7; 5 = 1 × 5; 13 = 1 × 13.	—Cuisenaire rods
2. more than 2 factors	The other group consists of numbers having more than two factors, e.g., 4 = 1 × 4 = 2 × 2; 6 = 1 × 6 = 2 × 3, factors are 1, 2, 3, 6. NOTE: One is a unique number being neither prime nor composite.	
IV. **ROMAN NUMERALS** The student should be able to:		
— read and write Roman numerals up to 20 or XX	A discussion of the structure of the Roman numeration system leads to an appreciation of the simplicity of our base ten (decimal) number system. A number could be written in Hindu-Arabic as well as Roman numerals and similarities and differences could be discussed.	—odd clock faces —coffee stirrers

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Perhaps some research of instances where Roman numerals are still found could be instigated. Numerals could be constructed using coffee stirrers or rods. Ten is still the most important concept. EXTENSION: Roman numerals to XXXIX.	
V. STUDY OF WHOLE NUMBERS 0 TO 999 **A. Place Value up to 999** **The student should be able to:**		
1. count, read, and write numerals up to 999	Most children can count orally by hundreds and in the hundreds, but many of them have difficulty reading and writing 3-digit numbers. The following is a game which helps children overcome this difficulty. In a small box put index cards each of which has a 1-digit numeral on it. The child draws three cards and arranges them to form a 3-digit numeral, reads it, writes it and then forms another 3-digit numeral with the same cards. For example, a child draws out a 2, a 4 and a 7. He/she makes 247, 472, 724, 274. An added activity would be to arrange the numerals in order of size.	—numeral cards
2. identify a number as it relates to other numbers: **a. as coming before or after** **b. by being larger than or smaller than** **c. by writing the symbols <, =, > in a number sentence**	Find a number on the hundred board, e.g., 53. Where could we find it—between 40 and 50? 50 and 60? Answer—between 50 and 60. Is it more than 50? How much more? Which number comes just before 53? Right after? Children could be given a set of numeral tickets, e.g., 20. Students are asked to place them as quickly as they can in the order from smaller to larger — when numbers are missing the child could supply the missing numbers orally, or write the numerals on small slips of paper. A friend could then read and check the sequence.	—a random selection of 20 numeral tickets —sets of numeral tickets —100 board

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Expanded Notation The student should be able to: – write a numeral in expanded form	Children should be made aware that 100 is made up of ten sets of 10. This should be illustrated by using concrete materials. The teacher might show 3 flats (hundreds), 4 strips (tens), 5 squares (ones). The children are asked to name how many hundreds, tens and ones there are. The numeral can thus be written where each digit corresponds to the number of hundreds, tens and ones. A number is given and the child is asked to give the number of hundreds, tens and ones. This can be written as an addition sentence (expanded notation). e.g., $248 = 2$ hundreds $+ 4$ tens $+ 8$ ones $200 + 40 + 8$ Another way of recording a number is by using a place value grid: $\begin{array}{c\|c\|c} H & T & O \\ \hline 2 & 4 & 8 \end{array}$ This is not expanded notation.	—Dienes blocks —squared paper in units of ones, tens and hundreds —money — dollars, dimes, and pennies —abacus —bundles of tens, hundreds (10 tens)
C. Regrouping The student should be able to:		
1. rename a 2-digit number by regrouping	Review and re-teach if necessary. See grade 3 section.	
2. rename a 3-digit number by regrouping a. tens to units	Students should be able to see and to verify that a number which has been regrouped still has the same value. e.g., $342 = 300 + 40 + 2$ $= 300 + 30 + 12$ or $\begin{array}{r} 300 \\ 40 \\ +\ 2 \\ \hline 342 \end{array}$ or $\begin{array}{r} 300 \\ 30 \\ +12 \\ \hline 342 \end{array}$ check — using appropriate materials — by addition	—popsicle sticks (in groups of 10) —centimetre square paper cut into ones, tens, hundreds
b. hundreds to tens	e.g., $342 = 300 + 40 + 2 = 3(100) + 4(10) + 2(1)$ $= 200 + 140 + 2 = 2(100) + 14(10) + 2(1)$	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Rounding Off **The student should be able to:**		
– round off to the nearest hundred	It is essential that students have had experiences and are proficient in rounding off to the nearest 10. In a sequence of numbers between two consecutive multiples of a hundred, round off to the nearest hundred, e.g., between 200 and 300, is 215 closer to 200 or 300? *Game* — two children are given cards with multiples of 100, e.g., 200, 300. Another child is given a number between the two, e.g., 268. The child has to decide which one of the other two children to stand beside to show which hundred is closer to his/her number. NOTE: It is common practice to move from 250 to 300, 350 to 400, etc.	
E. Addition and Subtraction **The student should be able to:**		
1. add and subtract multiples of 10 and 100	Children should become quite efficient in adding and subtracting multiples of 10 and 100 orally and in writing before proceeding to addition and subtraction of 3-digit numbers, e.g., 20 + 30, 400 + 300, etc.	
2. add and subtract up to two 3-digit numbers		
a. without regrouping	$\begin{array}{r} 342 \\ +127 \\ \hline 469 \end{array}$ $\begin{array}{r} 342 \\ -121 \\ \hline 221 \end{array}$	—Dienes blocks —bundled sticks —paper cut-outs of ones (squares), tens (strips), hundreds (flat) —centimetre squared paper would be useful
b. i. with regrouping from ones to tens **ii. with regrouping from tens to ones**	i. $\begin{array}{r} 342 \\ +\ 29 \\ \hline 371 \end{array}$ ii. $\begin{array}{r} 342 \\ -129 \\ \hline 2[illegible]3 \end{array}$	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. i. **with regrouping from tens to hundreds** ii. **with regrouping from hundreds to tens**	$\begin{array}{r} 243 \\ +194 \\ \hline 437 \end{array} \qquad \begin{array}{r} 527 \\ -184 \\ \hline 343 \end{array}$	
d. **with two regroupings**	$\begin{array}{r} 368 \\ +175 \\ \hline 543 \end{array} \qquad \begin{array}{r} {\scriptstyle 2161} \\ \cancel{3}\cancel{7}5 \\ -197 \\ \hline 178 \end{array}$	
e. **with zeros**	Zero does not present too much difficulty in the addition algorithms, but the subtraction algorithm involving zeros needs special attention. Steps in the process are: i. $\begin{array}{r} 409 \\ -\underline{251} \end{array}$ → renamed as 3 hundreds 10 tens 9 ones Illustrating this with material will show the child that now he/she can remove 5 tens from the 10 tens. ii. $\begin{array}{r} 400 \\ -\underline{137} \end{array}$ 400 will have to be renamed because we have a zero in the ones and in the tens place. So 400 becomes 3 hundreds and 10 tens. We still need further renaming to obtain ones. So we have 3 hundreds, 9 tens and 10 ones. The algorithm arrived at will appear as follows. $\begin{array}{r} {\scriptstyle 391} \\ \cancel{4}\cancel{0}0 \\ -137 \\ \hline 263 \end{array}$ Now subtraction is possible. $\begin{array}{r} {\scriptstyle 391} \\ \cancel{40}0 \\ -137 \\ \hline 263 \end{array}$ Rename 400 as 40 tens, regroup and move one ten to ones.	
Multiplication and Division **F. Multiplication** The student should be able to: 1. **multiply multiples of 10 and 100 by 1-digit numbers**	Continue work on the multiplication and division facts, emphasizing multiplying by 10 and multiples of 10.	—bundled sticks —paper cut-outs of ones, tens and hundreds

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<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
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3 × 50 = 3 × 5 tens or 15 tens or 150; 4 × 200 = 4 × 2 hundreds or 8 hundreds or 800 (both orally and in writing).

The ability to compute quickly, e.g., 3 × 20 or 3 × 2 tens, will lead to a better understanding of the procedures involved in the algorithm.

$$\begin{array}{r} 20 \\ \times\ 3 \\ \hline \end{array} \qquad \text{3 sets of 20} \qquad \begin{array}{r} 20 \\ 20 \\ +20 \\ \hline 60 \end{array}$$

$$\begin{array}{lcl} 2\ \text{tens} & + & 0\ \text{ones} \\ & \times & 3 \\ \hline 6\ \text{tens} & + & 0\ \text{ones} \\ 60 & + & 0 \\ 60 & & \end{array}$$

</td><td>—Dienes blocks</td></tr>
<tr><td>

2. **begin to use the multiplication algorithm**
   a. without regrouping

</td><td>

The process of multiplication and division should be illustrated with material.

$$\text{3 sets of 23} \longrightarrow \begin{array}{r} 23 \\ 23 \\ +23 \\ \hline 69 \end{array}$$

$$\begin{array}{lcl} 2\ \text{tens} & + & 3\ \text{ones} \\ & \times & 3 \\ \hline 6\ \text{tens} & + & 9\ \text{ones} \longrightarrow \\ 60 & + & 9 \quad = 69 \end{array} \quad \begin{array}{c|c} T & O \\ \hline 2 & 3 \\ \times & 3 \\ \hline 6 & 9 \end{array} \longrightarrow \begin{array}{r} 23 \\ \times\ 3 \\ \hline 69 \end{array}$$

</td><td>—overhead projector and bundles of 10</td></tr>
<tr><td>

   b. with regrouping

</td><td>

$$\text{4 sets of 24} \longrightarrow \begin{array}{r} 24 \\ 24 \\ 24 \\ +24 \\ \hline 96 \end{array}$$

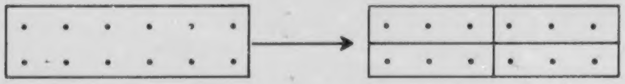
$$\begin{array}{lcl} 2\ \text{tens} & + & 4\ \text{ones} \\ & \times & 4 \\ \hline 8\ \text{tens} & + & 16\ \text{ones} \longrightarrow \\ 9\ \text{tens} & + & 6\ \text{ones} = 96 \end{array} \quad \begin{array}{c|c} T & O \\ \hline 2 & 4 \\ \times & 4 \\ \hline 1 & 6 \\ 8 & 0 \\ \hline 9 & 6 \end{array} \longrightarrow \begin{array}{r} \text{Short Algorithm} \\ 24 \\ \times\ 4 \\ \hline 96 \end{array}$$

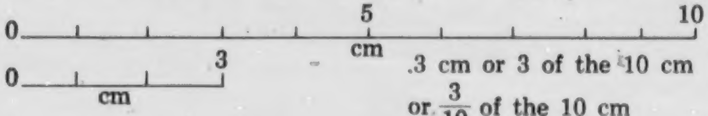
</td><td></td></tr>
</table>

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	It is not necessary that the children do all these steps all the time. They are introduced to create a better understanding of multiplication and an appreciation of the short algorithm.	
G. Division **The student should be able to:**	Review the meaning of division as:	
1. find the number of equivalent subsets in a given set	a. finding the number of equivalent subsets in a given set. (Use concrete materials on overhead.)	
2. find the missing factor	b. as the inverse of multiplication. $3 \times \square = 12$ $12 + 3 = 4$	
3. use the symbol ÷ in a number sentence	This could be interpreted as: a. 12 divided by 3 = 4 b. 3's in 12 = 4 NOTE: This will lead to the introduction of the division algorithm — $\begin{array}{r}4\\3\overline{)12}\end{array}$	
4. begin to illustrate and solve a simple division problem in several ways	e.g., I have 8 candies. I want to share them with friends. How many friends will get 2 candies each? The student should be able to illustrate the solution to the problem in any of the above formats.	—egg cartons separated into sections —container lids —paper plates —objects

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. solve a simple division problem with a remainder	e.g., How many 4's in 9? The student will be able to see that there are two group's of 4 and one remaining. $\begin{array}{r} 2^{1} \\ 4\overline{)9} \end{array}$ $\begin{array}{r} 4^{2} \\ 4\overline{)18} \end{array}$ NOTE: There should be considerable emphasis on tactile or visual experiences.	
VI. FRACTIONS The student should be able to:		
1. identify and name a fraction (unit fractions) as part of a unit, e.g., $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$	Reintroduce the meaning of fractions by using material from the environment in a relevant problem situation. Models of fractions can be constructed by the students by folding, cutting, sharing and comparing material in order to identify a fraction as being a part of a unit subdivided into a number of equal-sized parts.	
2. identify and name a fraction as part of a set of objects	The students should be able to relate the fraction to the division operation. (Partitive division, i.e., as being part of a set of objects.) e.g., Mother has 12 cookies to share equally among her four children. How many cookies will each child get? 	—paper geometric shapes —flannel cut-outs —fraction strips —transparencies —paper plate —number line —cubes taped together —counters —egg cartons

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	There are four parts, each containing 3 cookies. The answer to the problem could be expressed as: i. $12 \div 4 = 3$ 3 cookies each ii. $\frac{1}{4}$ of $12 = 3$ 3 cookies each	
3. identify and name non-unit fractions e.g., $\frac{2}{4}, \frac{2}{3}, \frac{3}{4}$	These could be introduced through the use of appropriate material and meaningful interaction. E.g., fold and cut a circle into four equal parts. Give one-fourth to John, one-fourth to Jim. How many fourths have you given away so far? Two-fourths — two of the four equal parts. Show me another fourth. Now that is how many of 4 equal parts — three of the four. Relate the word *one-fourth* with the symbol $\frac{1}{4}$ as well as *two-fourths* with $\frac{2}{4}$.	—Cuisenaire rods —cubes —cardboard plates — geometric shapes
4. identify and name unit and non-unit fractions related to metric measure $\frac{1}{10}, \frac{2}{10}, \frac{3}{10}$ etc., of 10 cm	Children should be encouraged to use the 10 cm or 20 cm ruler to construct and/or measure lines shorter than 10 cm.  .3 cm or 3 of the 10 cm or $\frac{3}{10}$ of the 10 cm NOTE: The student should have *many* experiences in measurement activities which will gradually help him/her to understand or internalize the concept.	
VII. DECIMALS **A. Tenths** The student should be able to: — rename the unit or non-unit fractions above as decimals	See grade 2 section. e.g., $\frac{1}{10}$ as 0.1 $\frac{2}{10}$ as 0.2 $\frac{3}{10}$ as 0.3 1 dime $= \frac{1}{10}$ of a dollar $=$ \$0.10 2 dimes $= \frac{2}{10}$ of a dollar $=$ \$0.20	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Hundredths The student should be able to: – read and write amounts of money less than one dollar	The dollar should be discussed as equivalent to 100 pennies and this will lead to the penny being named $\frac{1}{100}$ or \$0.01, 24 pennies = $\frac{24}{100}$ or \$0.24. \$0.24 would be explained as meaning no dollars and 24 cents or 0 dollars and 24 cents. Price tags could be made and distributed to the children who would be asked to explain the value indicated.	—real money —play money —store items with price tags —100 board —centimetre square paper
VIII. GEOMETRY **A. 3-D Shapes** **sphere** **cylinder** **cube and/or cuboid** **cone** **pyramid** The student should be able to: – classify 3-D shapes according to a specific attribute or characteristic	Students should have many experiences investigating 3-D shapes in the environment, as well as geometric models of the 3-D shapes and classifying them according to shape, size, use, etc.	—shapes in our environment —solid shapes—a supply of objects for sorting and classifying, e.g., shapes like cubes, cylinders —geoboard
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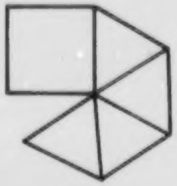
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: The analysis of 3-D shapes leads directly towards recognition of 2-D shapes and their attributes. Tracing the faces of 3-D shapes on paper will produce several 2-D shapes (nets). Pyramid 	—squared paper —pictures of shapes in our environment —two-dimensional cut-outs
B. 2-D Shapes (Plane) **square** **rectangle** **circle** **triangle** The student should be able to: 1. compare 2-D shapes to show: a. similarities b. differences 2. classify 2-D shapes according to a specific attribute	Two-dimensional cut-outs (squares, rectangles, triangles, circles) could be examined and compared. Consequently, the 2-D shapes can be classified according to their properties. This is mainly a review activity to evaluate the students ability to recognize, name, and describe 2-D shapes.	
C. Angles, Lines The student should be able to: — locate (do not define) angles, parallel lines, straight lines and curved lines	The main emphasis should be on the explaining of the environment to develop an awareness of these concepts. e.g., angles on a desk, angles using scissors, curves on light fixtures, parallel lines on doors, windows, railroad tracks . . . NOTE: *Do not* introduce definitions at this stage. Just try to develop an understanding of the different representations of lines and angles.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Many-sided Plane Shapes (Regular)		
The student should be able to:		
1. explore the structure of 3-, 4-, 5- and 6-sided regular shapes	Emphasis should be on the identification of many-sided shapes in our environment. Do not introduce terminology. A regular shape has all sides equal, e.g., equilateral triangle, square.	—stop signs —sheet of paper —plastic models —J-cloth boxes (trace base)
2. reproduce a. a square b. a rectangle c. a line segment	This reproduction could be done first on geoboard, second, on squared paper. Verify by superimposing, tracing, or measuring and describing.	—geoboard —squared paper —geopaper
E. Perimeter		
The student should be able to:		
— find the distance around a shape	No formula. This should be directly related to measurement activities. e.g., — run the distance around the gym, the school yard, etc. — measure with non-standard and standard units	—string (non-standard) —metric tape
F. Symmetry		
The student should be able to:		
— locate and identify lines of symmetry	Review the concept of symmetry by referring to symmetry in nature and in designs. Explore paper folding to identify a line (or lines) of symmetry.	—mirror cards —MIRA —mirrors —tracing paper —waxed paper

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Apply to geometric shapes — triangle, square, rectangle, circle. NOTE: Integrate with other subject areas, e.g., science, art, physical education.	
IX. MEASUREMENT	Estimating should accompany all measuring activities. The process of estimating involves comparing the selected unit of measurement with the item being measured to determine, without actual measuring, the *approximate* number of units in the item. The item will then be measured with the unit and this actual result compared with the estimated result. Initially, the students just guess, however, this process of estimation will improve.	
A. Linear Measurement	Measurement activities should be integrated with geometry. Students should be involved in some activities which will review the concept of measurement using non-standard units and then using the standard units, metres and centimetres. NOTE: In all measurement activities, the unit of measure chosen must possess the quality of the property which is being measured. e.g., You must measure area using a square unit of measure.	
The student should be able to: 1. demonstrate the relationships among the metre, the decimetre and the centimetre	Cuisenaire rods are excellent models to show some of these relationships. Do a great deal of work in multiples of ten. The meaning of the prefixes "deci" and "centi" should be studied. A place value grid is beneficial to show written work. m | dm | cm 1 | 2 | 5 Can be written as 125 cm or 1.25 m or 1 m + 2 dm + 5 cm.	—Cuisenaire rods —metre stick —metric survey tape —metric trundle wheel —string calibrated in metres —30 cm rulers —20 cm rulers

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **demonstrate knowledge of the relationships between metre and centimetre in written exercises**	Actual measuring exercises should precede these written exercises. For example: 1 metre = 100 centimetres 2 metres = _____ centimetres 300 centimetres = _____ metres 220 centimetres = _____ m _____ cm	
B. Area The student should be able to:		
– **illustrate and explain the concept of area using materials** 1. non-standard	Review the concept of area using non-standard units to cover a designated surface, e.g., how many hands, books, are required to cover a desk top?	
2. standard (m^2 and cm^2)	Out of these experiences the students are led to discover the need for a uniform or standard unit. The standard unit of area for small surfaces is cm^2 and for larger surfaces it is the m^2.	—centimetre squared paper —Cuisenaire rods —square metre —centimetre squares
	Children should have many experiences covering a two-dimensional space using square centimetres. A variety of problems will help develop the meaning of this concept. NOTE: Formula for finding area *should not* be introduced.	
C. Volume The student should be able to:		
1. **illustrate and explain the concept of volume using non-standard materials**	The concept of volume should be reintroduced by having students involved in many activities filling 3-D spaces (boxes) with blocks, cubes.	—blocks —cubes

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. order two or more 3-D shapes according to volume	Do this according to the number of blocks, etc., it takes to fill the various 3-D shapes. NOTE: The formula for finding the volume of an object *should not* be introduced.	—centicubes —Cuisenaire rods
D. Capacity The student should be able to:		
1. illustrate and explain the concept of capacity using materials	Review the relationship using non-standard units. Practical problems should be solved to discover the relationship between litres and millilitres.	—litre containers —containers graduated in millilitres —small ungraduated containers —bottles in a variety of sizes more than and less than a litre
2. order several containers according to capacity by: a. estimating b. measuring	Some of these activities would serve as illustrations of fractions, e.g., half-litre. This could lead to discovering the relationship between litre and millilitre. $1\ \ell = 1000$ ml	—many empty containers —bottles —cans —pails —milk cartons
3. demonstrate knowledge of the relationship between the litre and the millilitre	Students should be involved in many actual measuring activities and record answers in litres and/or millilitres before proceeding to formal written work.	
E. Mass The student should be able to: 1. compare two objects and determine:		
a. the heavier one b. the lighter one	Children should have many opportunities to measure the mass of various things on the balance scale and on the spring or compression scale. Following many experiences, they will be able to determine which unit of measurement they require.	—spring scale, compression scale —balance scale with metric masses

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **use non-standard units to determine the mass of an object**		—small objects — quarters, paper clips, pencils, oranges
3. **use standard units to determine the mass of an object**	The units for measuring mass are the kilogram and the gram. It is most helpful if children make 100 g weights by filling baggies with sand, beans, etc., and use them as standard units.	—beans —sand —pebbles —grains
F. Money		
The student should be able to:		
— solve problems related to money situations	Using problems related to the real world help the students become more aware of consumer buying. Comparing advertisements in newspapers leads to discussions on best buys. Creating store situations or visiting stores would make the learning experiences more meaningful. There are many opportunities for integration of language arts, social studies, measurement and an informal introduction to addition and subtraction with decimals.	—newspaper ads —store bills —fliers —catalogues —real money —toy money
G. Time		
The student should be able to:	Review:	
1. recall and illustrate:		
a. the divisions of a day	a. the divisions of a day (morning, noon, afternoon, evening, night)	
b. the days of the week	b. the days of the week	
c. the months of the year	c. months of the year	
d. the concepts of yesterday and today	d. concepts of yesterday, today, and tomorrow	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. read and write the time indicated (on a 12-hour clock) to the nearest 5 minutes	Review telling time by the hour, the half-hour and the quarter-hour, then begin looking at the five-minute interval marks and then begin reading (and writing) the time indicated on a clock. Discuss, and read the digital clock or watch as compared to reading and writing the time from a traditional clock.	—cardboard clock face —spirit master of clock faces —television schedules
H. Temperature The student should be able to:		
— read and record the temperature indicated on a Celsius thermometer and interpret the reading	Students should read and record the daily temperatures. In discussion, a) they should interpret the meaning of the temperature as hot, warm, cool, cold, freezing, etc.; b) compare it with yesterday's or last month's temperature, e.g., warmer, cooler, etc.; and c) predict what tomorrow might be.	—Celsius thermometer —weather charts
	Estimate the temperature of certain matter, e.g., three beakers containing ice cold, lukewarm and very warm water. Measure the temperature for each and compare the results. (See science guide.)	—thermometer —beakers (water)

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
X. GRAPHING **The student should be able to:**		
1. gather, record and illustrate the data by means of: **a. concrete graph** **b. concrete bar graph** **c. pictograph** **d. bar graph**	The teacher should do many graphs with the entire class before expecting student proficiency in constructing graphs. Graphing is an attractive way of illustrating facts in a comprehensive form. Graphs should grow out of other subject areas, e.g., health, science, social studies. Data is collected and tallied prior to the construction of the graph, and may be shown in various ways. From this graph students observe relationships which are basic to the understanding of mathematics. The graphs show a one-to-one relationship. Interpretation of the graph is facilitated by both the teacher's and pupils' asking questions about it. Interpretation could be correlated with language arts, in that the interpretations could be recorded as an experience chart.	—real things —blocks or objects to represent data —pictorial representations —graph paper or ruled paper —geoboards and straws of varying lengths or Unifix cubes (*hole* in centre) to pile up on geoboard
2. interpret any of the above types of graphs: **a. orally** **b. in writing**	*Suggested topics:* 1. measurement records 2. milk sales at school over a period of time 3. topics related to the social studies and science programs 4. weather 5. game scores 6. favourite television characters 7. number of library books read 8. number of bubble gum cards collected 9. skipping scores 10. breakfast foods 11. tea ticket sales 12. number of children in family	
3. give a meaningful title to the graph	EXTENSION: Depending on the size of the data, one object or symbol may represent more than one unit, e.g., one circle can represent two, three or ten people.	

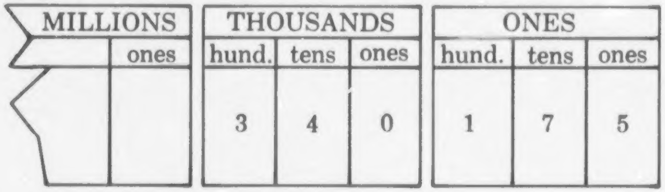
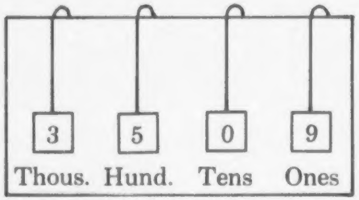
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
XI. ESTIMATING	This is a very important concept in mathematics throughout all grades K-12 and should be used extensively in calculations and problem solving. When dealing with addition and subtraction problems involving 2-digit numerals, it is most important that the children learn to do some quick estimating based on rounding off to the nearest ten. This should be done mentally, e.g., 21 + 47 — we think 20 + 50 = 70, so the answer should be about 70. Then the children solve the problem and check their answer, comparing it with the estimation.	
XII. PROBLEM SOLVING **A. Oral** The student should be able to: — solve oral problems	The type of problem that is ideally suited to your pupils is one that relates to their experiences and also uses skills that need reinforcing. Problems should be a part of your daily program. Oral problems should be given whenever the opportunity arises. It is also desirable that the children compose problems and ask questions of their peers. The answers could be illustrated by the use of manipulative material, or by drawings or diagrams.	—manipulative materials —counters —set surrounds —flannelboard and material

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	A picture could be analyzed and described orally, e.g., a picture of a park. The discussion could centre around the people in the picture, the animals or the trees. We could find out how many animals there are in the picture, for example, 2 dogs, 5 squirrels, 4 rabbits could be written as $2 + 5 + 4 = \square$. Children should be encouraged to make an oral number sentence as well as a language sentence to determine if the question has been answered. Also, the reverse could happen, where the teacher gives a mathematical sentence and asks the children if they could tell a story about this. Exercises in solving word problems should be conducted as a group activity under the guidance of the teacher.	—magnetic board and material —pictures to discuss —number line —paper cut-outs —blackboard diagrams —toy money —fliers (shopping items)
B. Written The student should be able to: — solve written problems	When the children have had many oral experiences in solving word problems, simple written problems could be introduced. Read the problem critically to find: —what information is known —what question is asked —how to find the answer (the process needed) —estimate the answer Write the mathematical sentence. The sentence can be represented in many ways, e.g., $12 - 4 = \square$ or $4 + \square = 12$ or $12 = 4 + \square$, etc.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	The children should be permitted to express the sentence in their own way. Solve the problem. Check to see if the answer is reasonable by comparing it with the estimated answer. It is suggested that relevant and interesting questions or problems be used and the different levels be appropriate so as to promote a positive attitude toward problem solving. NOTE: To become an efficient problem solver it is necessary to: 1. have a positive attitude toward problem solving; 2. have the ability to use mathematics and other skills to solve problems. Attitudes cannot be taught outright, but can be fostered through meaningful interaction between the teacher and students as well as among the students themselves.	

Fractional Parts

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. NUMBER: 4-, 5- AND 6-DIGIT NUMBERS	Four-, five- and six-digit numbers are now being introduced formally. The intent here is to give students a better insight into the structure of our number system. It is of the utmost importance that students are thoroughly familiar with the place value of three-digit numbers (reading and writing of these numbers) before proceeding to larger numbers. e.g., 340 175 can be illustrated in the period grid  MILLIONS ones THOUSANDS hund. tens ones ONES hund. tens ones 3 4 0 1 7 5 NOTE: Each group of three digits is called a period, e.g., ones period, thousands period, millions period, etc. In metric editions of some textbooks, the comma has been removed from period groupings, e.g., 54,256 and replaced with a space, i.e., 54 256. This is in compliance with SI metric specifications. In four-digit numbers the space may or may not be left.	The following materials are useful for section I, A to G: —abacus —popsicle sticks —toothpicks —plastic or wooden spoons —straws —counters —egg cartons —Unifix cubes —metricubes —Cuisenaire rods —graph paper —Dienes blocks —number chart 1-100, 100-200, etc. —geoboard —bean sticks —digital adding machine —odometer counters
A. Place Value The student should be able to: 1. read and write numbers up to six digits, including zero as a place holder 2. give the value of any digit in a number	GAME:  10 cards on each loose-leaf ring with numbers 0-9. Students flip over the cards and practice reading the numbers.	

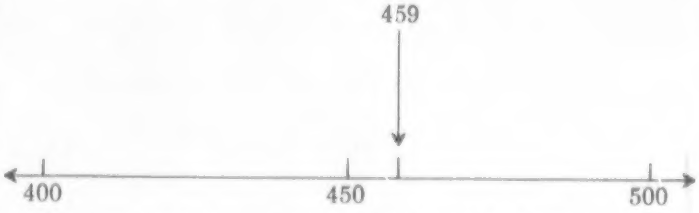
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	GAME: 2-3 players. Make up 20 cards with numerals 0-9. Make each numeral twice. Each child makes a placeholder chart, e.g., H. Th. T. Th. Th. H. T. O. Children take turns drawing a card and placing it on their place value chart. The object of the game is to see who has the largest number.	
B. Expanded Notation The student should be able to: — write numbers in expanded form	$2437 = 2$ thousands $+ 4$ hundreds $+ 3$ tens $+ 7$ ones $= 2000 + 400 + 30 + 7$ This will reinforce the concept of place value.	
C. Renaming Numbers The student should be able to: — rename a number in many ways	A number can be expressed in many different ways, e.g., $36 = 30 + 6 = 35 + 1 = 40 - 4 = 6 \times 6 = 4 \times 9 = 3 \times 12 = \frac{1}{2}$ of 72, etc. This can be done as a group or individual activity. This is intended to facilitate the *understanding of number.*	
D. Regrouping Numbers (Renaming by Place Value) The student should be able to: 1. regroup a number using concrete materials	Money can be used most meaningfully to exemplify regrouping, i.e., 2 dimes and 1 penny (21¢) to 1 dime and 11 pennies (21¢), etc.	—money —popsicle sticks —Dienes blocks —Unifix cubes —abacus —Cuisenaire rods —bean sticks

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>**2. regroup a number without concrete materials**</td><td>This concept is essential when working with operations.

The terms "borrowing" and "carrying" are often used to express "regrouping".

15 = 10 + 5
+ 18 = 10 + 8
(10 + 10) + (5 + 8)
20 + 13
30 + 3
33
<table>
<tr><th>Tens</th><th>Ones</th></tr>
<tr><td>1</td><td>5</td></tr>
<tr><td>+1</td><td>8</td></tr>
<tr><td>2</td><td>13</td></tr>
<tr><td>3</td><td>3</td></tr>
</table>
<table>
<tr><th>Tens</th><th>Ones</th></tr>
<tr><td>1</td><td>5</td></tr>
<tr><td>+1</td><td>8</td></tr>
<tr><td>1</td><td>3</td></tr>
<tr><td>2</td><td></td></tr>
<tr><td>3</td><td>3</td></tr>
</table>
15
+18
33</td><td></td></tr>
<tr><td>**E. Rounding Off**

The student should be able to:

— **round off whole numbers to the nearest of any of the five possible digits in a possible six-digit number**</td><td>

459 rounded to the nearest hundred would be 500

NOTE: When rounding off a "5", the student should be directed to raise it to the next higher value.

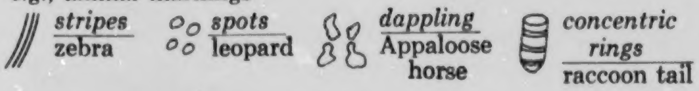
e.g., 15 → 20 (tens)
750 → 800 (hundreds)
15 876 → 15 880 to tens
→ 15 900 to hundreds
→ 16 000 to thousands
→ 20 000 to ten thousands</td><td>—number line</td></tr>
<tr><td>**F. Decimal Notation**

The student should be able to:

— **read and write 2-place decimal notation in reference to money and metric measurement**</td><td>Two-place decimal notation has been introduced informally in grade 3. It should be reinforced continually.</td><td></td></tr>
</table>

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
G. Equalities and Inequalities The student should be able to: **– use the appropriate symbol(s), <, =, ≠, >, to make a number sentence true (≠ is introduced for first time)**	3 + 5 ⊜ 4 + 4 24 < 25 8 × 3 ⧀ 30 — 5 24 ≠ 25 8 × 3 ≠⃝ 30 — 5 Number sentence games are recommended to establish a good understanding of the concepts of equality and inequality and to reinforce these concepts.	—cards (numerals) —open number sentence cards $\boxed{5} > \boxed{2}$ $\boxed{3} + \boxed{4} = \boxed{7}$ $\boxed{7} + \boxed{8} \neq \boxed{16}$ —"Krypto"
II. ROMAN NUMERALS The student should be able to: **1. recognize and translate I, V, X, L, C, D, and M into Hindu-Arabic equivalents and vice versa**	The teacher should attempt to make Roman numerals relevant by providing specific examples, i.e., clocks, preface pages, book chapters, library books, etc.	—clocks —books
2. translate, read, and write numbers from I to C, applying the appropriate rules of usage	Roman numerals are not place value numbers.	
III. NUMBER THEORY **A. Patterns** The student should be able to: **1. identify, construct and complete simple patterns using concrete materials**	Please refer to notes on program implementation for discussion on patterns. A brief review of concrete patterns would provide a good introduction for all students. Attribute blocks, shoes, students, etc., can be arranged into concrete patterns: △ ● □ ■ △ ● □ ■ △ ● _ _ _	—attribute blocks —Unifix cubes —parquetry tiles —beads —bottle tops —buttons

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Supply the next 6 objects to the pattern above to complete the pattern.	—ceramic tiles —pictures of objects —blocks —spools —straws —pegboards (pegs)
2. identify, construct, and complete simple pictorial patterns:		
a. natural	Seasons, stellar constellations, life cycles, water cycle, migration of birds, flowers, leaves, animal markings (camouflage), etc. e.g., animal markings  *stripes* zebra *spots* leopard *dappling* Appaloose horse *concentric rings* raccoon tail	—pictures of constellations —animal pictures —maps (migratory) —sea shells
b. man-made	Architecture, music (rhythm), art, streets and roads, sports, mechanization (assembly-line production), habits and routine activities, procedures related to occupations and daily life, wallpaper, wrapping paper, etc. e.g., streets and roads Concentric Grids Crescents	—pictures of buildings, etc. —recorded music —maps (streets, highways) —wallpaper —wrapping paper
c. identify numerical patterns on:		
i. hundred grid	Informal discovery sessions should be conducted with the hundred grid. After students have had sufficient practice in finding patterns, they should be directed to activities where they have to supply the missing numbers to complete the pattern. This should also be considered when using the addition and product grids.	—graph paper —overhead projector —transparency

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

1	2	③	4	5	⑥	7	8	⑨	10
11	⑫	13	14	⑮	16	17	⑱	19	20
㉑	22	23	㉔	25	26	㉗	28	29	㉚
31	32	㉝	34	35	㊱	37	38	㊴	40
41	㊷	43	44	㊺	46	47	㊽	49	50
(51)	52	53	(54)	55	56	(57)	58	59	(60)
61	62	(63)	64	65	(66)	67	68	(69)	70
71	(72)	73	74	(75)	76	77	(78)	79	80
(81)	82	83	(84)	85	86	(87)	88	89	(90)
91	92	(93)	94	95	(96)	97	98	(99)	100

Hundred Grid
Counting by 2's, ③'s, 4's, etc.,
to look for patterns.

NOTE: The sum of the digits on each diagonal.

ii. addition grid

FOLD HERE

9	9	10	11	12	13	14	15	16	17	18
8	8	9	10	11	12	13	14	15	16	17
7	7	8	9	10	11	12	13	14	15	16
6	6	7	8	9	10	11	12	13	14	15
5	5	6	7	8	9	10	11	12	13	14
4	4	5	6	7	8	9	10	11	12	13
3	3	4	5	6	7	8	9	10	11	12
2	2	3	4	5	6	7	8	9	10	11
1	1	2	3	4	5	6	7	8	9	10
0	0	1	2	3	4	5	6	7	8	9
+	0	1	2	3	4	5	6	7	8	9

FOLD HERE

Addition Grid

—graph paper
—coloured pencils

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

ii. **product grid — multiplication grid**

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Addition Grid: IT IS ADVISABLE TO ORIENT THE ADDITION GRID AS SHOWN. THIS WILL FACILITATE LATER WORK WITH COORDINATES.

1. Note the symmetry of the table by folding it along the diagonal (as shown).
2. Search for patterns such as same numbers, multiples of two, doubles, etc.
3. Illustrate commutative property, inverse operations, etc.

FOLD HERE

9	9	18	27	36	45	54	63	72	81
8	8	16	24	32	40	48	56	64	72
7	7	14	21	28	35	42	49	56	63
6	6	12	18	24	30	36	42	48	54
5	5	10	15	20	25	30	35	40	45
4	4	8	12	16	20	24	28	32	36
3	3	6	9	12	15	18	21	24	27
2	2	4	6	8	10	12	14	16	18
1	1	2	3	4	5	6	7	8	9
×	1	2	3	4	5	6	7	8	9

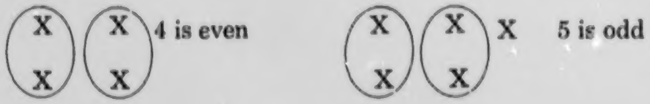
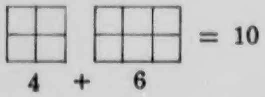
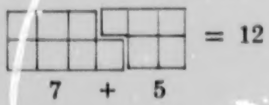
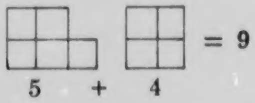
FOLD HERE

Product Grid

Product Grid: IT IS ADVISABLE TO ORIENT THE PRODUCT GRID AS SHOWN. THIS WILL FACILITATE LATER WORK WITH COORDINATES.

1. The product grid may be used as an area grid. Note the shaded section (3 × 2 = 6).
2. Note the symmetry of the table by folding it along the diagonal (as shown).
3. Search for patterns such as even numbers, odd numbers, square numbers, multiples.
4. Illustrate commutative property, inverse operations, multiples, etc.

SUGGESTED MATERIALS

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Even and Odd Numbers The student should be able to:		
1. show difference between even and odd numbers by grouping by twos	Even and odd patterns should be located on the grids illustrated in the previous section. Arrays can be arranged into groups of 2 to identify even and odd numbers. 	—small counters —overhead projector
2. predict the sum of: — two even numbers — two odd numbers — even and odd numbers	Grid paper provides an excellent device to illustrate: — the sum of two even numbers  The children should discuss the pattern that all multiples of 2 are even. — the sum of two odd numbers  — the sum of an odd and even number 	—graph paper
C. Factors The student should be able to: — find the factors of a product in the multiplication tables	Use the product grid or the methods described in the following section.	—"The Winning Touch"

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

D. Primes/Composites

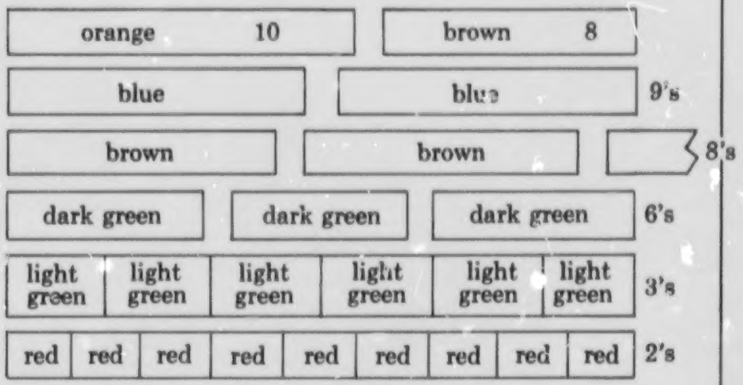
The student should be able to:

1. **list all prime numbers between 1 and 21**
2. **list all composite numbers between 1 and 21**

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

An approach to illustrating prime and composite numbers might include:

a. Cuisenaire Rods

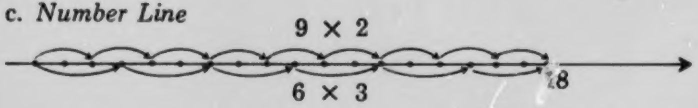

orange 10
brown 8
blue
blue
9's
brown
brown
8's
dark green
dark green
dark green
6's
light green
light green
light green
light green
light green
light green
3's
red
red
red
red
red
red
red
red
red
2's

When a set of rods of *one* colour can be arranged to correspond in length to the original set (18), the number represented by each rod is a factor of the original set, e.g., 1, 2, 3, 6, 9, 18.

Composite numbers will have more than one corresponding set, e.g., $18 = 3 \times 6$
$= 2 \times 9$
$= 1 \times 18$

Prime numbers will have only one corresponding set, e.g., one and itself — 7 = 7 × 1.

SUGGESTED MATERIALS

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. *Arrays* When using arrays to illustrate primes and composites the following condition must be applied, i.e., each array must contain two or more rows and columns. $\begin{array}{l}\text{XX}\\\text{X}\end{array}$ 3 This is the first number possible. It is prime. $\boxed{\begin{array}{l}\text{XX}\\\text{XX}\end{array}}$ 4 $\begin{array}{l}\text{XX}\\\text{XXX}\end{array}$ 5 $\boxed{\begin{array}{l}\text{XXX}\\\text{XXX}\end{array}}$ 6 $\begin{array}{l}\text{XXX}\\\text{XXXX}\end{array}$ 7 $\boxed{\begin{array}{l}\text{XXXX}\\\text{XXXX}\end{array}}$ 8 $\boxed{\begin{array}{l}\text{XXX}\\\text{XXX}\\\text{XXX}\end{array}}$ 9 $\boxed{\begin{array}{l}\text{XXXXX}\\\text{XXXXX}\end{array}}$ 10 $\begin{array}{l}\text{XXX}\\\text{XXXX}\\\text{XXXX}\end{array}$ 11 etc. Primes cannot be enclosed by a rectangle. A special case must be made for "2" which by definition is prime.	—small counters —geoboards and elastics circling nails
	c. *Number Line*  Composite numbers have more than two factors, e.g., 18 has 1, 2, 3, 6, 9, and 18.	—number line

EXTENSION:

State which numbers (up to 3 digits) are divisible by:

— 2

— 4

— 5

— 10

Divisibility Rules

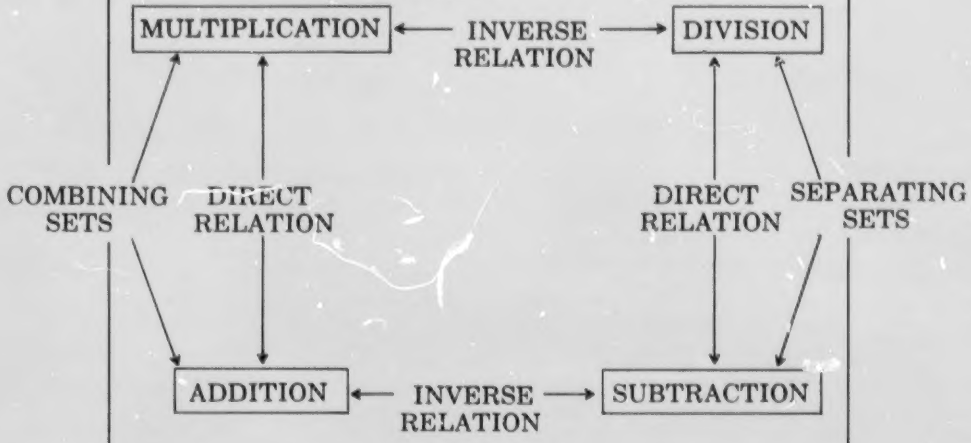
2 — An integer has 2 as a factor if, and only if, the last digit is 0, 2, 4, 6, or 8.

4 — An integer is divisible by 4 if, and only if, the number represented by the last two digits is divisible by 4, e.g., 13$\underline{32}$.

5 — An integer is divisible by 5 if, and only if, the last digit is 0 or 5, e.g., 1$\underline{5}$, 48$\underline{0}$, 50$\underline{5}$.

10 — An integer is divisible by 10 if, and only if, the last digit is 0, e.g., 613$\underline{0}$.

Following discovery, the rules should be maintained through application rather than rote memorization.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
IV. OPERATIONS	The four operations are related.  MULTIPLICATION INVERSE RELATION DIVISION COMBINING SETS DIRECT RELATION DIRECT RELATION SEPARATING SETS ADDITION INVERSE RELATION SUBTRACTION	
Addition and Subtraction **A. Addition** **1. Number Sentence** The student should be able to: — illustrate concretely or pictorially the meaning of an addition number sentence	The meaning of addition can best be reviewed by letting the students join sets to form a new set.	Use the following materials for skills 1 to 5: —dice with numerals —card games ("Concentration") —"Math Drag" (*Mathaction* grade 4) —number line —bean bag toss —dominoes —number chart —geoboard
2. Basic Facts The student should be able to: — recall with proficiency all basic addition facts	Use games to reinforce the facts and to provide the necessary drill.	
3. Addition of 10 and Multiples of 10 to a Given Number The student should be able to: — add 10 and/or multiples of 10 to a given number	Oral work involving addition of multiples of ten leads to proficiency in work with other addends. e.g., $\begin{array}{r} 15 \\ +\underline{30} \end{array}$ $\quad \begin{array}{r} 10+5 \\ +\underline{30} \\ 40+5 \\ \\ 45 \end{array}$ $\quad \begin{array}{r} 10+5 \\ +\underline{3(10)} \\ 4(10)+5 \\ \\ 45 \end{array}$	

Concepts and Skills are indicated in Bold Face.

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>4. Mathematical Properties
The student should be able to:
a. apply the commutative property to addition
b. apply the associative property to addition
c. apply the property of zero</td><td>commutative: $2 + 5 = 5 + 2$ (order)
associative: $2 + (9 + 6) = (2 + 9) + 6$ (grouping)
zero: $6 + 0 = 6$ (0 is the identity number of addition)
TERMINOLOGY NEED NOT BE STRESSED</td><td>—counters</td></tr>
<tr><td>5. Addition with Regrouping
The student should be able to:
a. regroup using expanded notation
b. regroup using the place value grid</td><td>Review addition without regrouping.
$$\begin{array}{rl} 262 & \longrightarrow 200 + 60 + 2 \\ +\underline{654} & \longrightarrow \underline{600 + 50 + 4} \\ & 800 + 110 + 6 = 900 + 10 + 6 = 916 \end{array}$$
$$\begin{array}{r} 262 \\ +\ \underline{654} \end{array} \quad \begin{array}{|c|c|c|} \mathrm{H} & \mathrm{T} & \mathrm{O} \\ \hline 2 & 6 & 2 \\ 6 & 5 & 4 \\ \hline 8 & 11 & 6 \\ 9 & 1 & 6 \end{array}$$
The examples explain the algorithm by expanded notation and place value. The children should be allowed to use the short algorithm as soon as they are ready to do so.</td><td>—Dienes blocks
—bean sticks
—popsicle sticks
—tags
—place value board
—abacus
—Unifix cubes</td></tr>
<tr><td>6. Column and Horizontal Addition
The student should be able to:
a. rewrite a horizontal addition sentence as a column addition algorithm
b. add three numbers of up to 4 digits each</td><td>$432 + 72 + 1348 = \square$ $$\begin{array}{r} 423 \\ 72 \\ +\ \underline{1348} \\ \boxed{} \end{array}$$</td><td></td></tr>
</table>

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
7. Addition with Money **The student should be able to:** **— add sums of money to the limits as described in 6b**	Children could make up shopping lists from fliers or catalogues and total the amount to be paid. Estimating skills could be applied here.	—real money —play money —catalogues —fliers —advertisements
8. Rounding Off for Estimation **The student should be able to:** **— round off numbers to 10's, 100's, and 1000's to estimate the sum**	Children add rounded-off numbers to arrive at an estimated sum. This estimated sum is a means of checking to see if the answer given is reasonable.	—number line
9. Checking Addition **The student should be able to:** **a. use the commutative property or associative property in checking column and horizontal addition**	Commutative Property $\begin{array}{r} 1567 \\ +\ 394 \\ \hline 1961 \end{array} \rightarrow \begin{array}{r} 394 \\ +\ 1567 \\ \hline 1961 \end{array}$	
b. group by tens to check column addition	Grouping by 10's $\begin{array}{rl} 1\ 1\ 2 & \\ 1\ 4\ 3\ 2 & \\ 1\ 7\ 9 & 10 \\ 6\ 4\ 8 & 9 \\ 3\ 0\ 7 & \\ +\ 4\ 0\ 3 & 10 \\ \hline 2\ 9\ 6\ 9 & \end{array}$	
10. Word Problems **The student should be able to:** **— use number sentences to solve word problems**	Thirty-five boys and twenty-seven girls went to camp. How many children in all went to camp? 35 + 27 = ☐ 35 + 27 = n etc. See section on problem solving.	— use concrete materials (counters) and picture representation to illustrate problems

Concepts and Skills are indicated in Bold Face.

<table>
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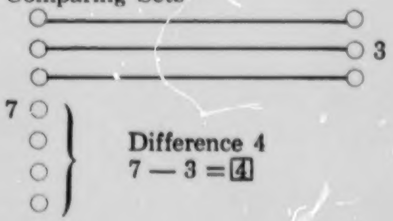
<tr><td>B. Subtraction
1. Number Sentence
The student should be able to:
— exemplify concretely or pictorially the meaning of a subtraction sentence</td><td>The meaning of subtraction can best be reviewed by having the students remove a subset from a set (inverse of addition). Addition: 8 + 4 = 12. Subtraction: 12 — 4 = 8. Other approaches include comparison of sets or finding the missing addend.
Comparing Sets


Difference 4
$7 - 3 = \boxed{4}$
Missing Addend
$5 + \square = 12$</td><td>—number chart
—abacus
—popsicle sticks
—toothpicks
—straws
—plastic spoons
—counters
—egg cartons
—Unifix cubes
—Dienes blocks
—Cuisenaire rods</td></tr>
<tr><td>2. Subtraction with Multiples of 10
The student should be able to:
— subtract 10 and/or a multiple of 10 from a given number</td><td>Much oral work involving the subtraction of tens develops proficiency which is directly related to proficiency in written work (algorithm).</td><td></td></tr>
<tr><td>3. Subtraction with Regrouping
The student should be able to:
a. regroup using expanded notation</td><td>a. $\begin{array}{r} 343 \\ -\underline{122} \end{array}$ $\begin{array}{r} 300 + 40 + 3 \\ -\ \underline{100 + 20 + 2} \\ 200 + 20 + 1 = 221 \end{array}$</td><td>—bundles of tens and ones (100 = 10 bundles of ten)
—abacus</td></tr>
<tr><td>b. regroup using the place value grid</td><td>b. $\begin{array}{r} 236 \\ -\underline{145} \end{array}$ $\begin{array}{r|c|c} H & T & O \\ \hline 2 & 3 & 6 \\ -1 & 4 & 5 \\ \hline & & \end{array}$ $\begin{array}{r|c|c} H & T & O \\ \hline {}^{1}\cancel{2} & {}^{1}3 & 6 \\ -1 & 4 & 5 \\ \hline & 9 & 1 \end{array}$ $\begin{array}{r|c|c} H & T & O \\ \hline {}^{1}\cancel{2} & \boxed{10\,{}^{3}} & 6 \\ -1 & 4 & 5 \\ \hline & 9 & 1 \end{array}$</td><td></td></tr>
</table>

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. regroup using zeros	$\begin{array}{r} 200 \\ -\ \underline{87} \\ 113 \end{array}$ $\begin{array}{r} \overset{191}{\cancel{200}} \\ -\ \underline{87} \\ 113 \end{array}$ $\begin{array}{r} \overset{191}{\cancel{200}} \\ -\ \underline{87} \\ 113 \end{array}$	
4. Subtraction of Whole Numbers		
The student should be able to:		
— subtract numbers with up to 4 digits	$\begin{array}{r} 4136 \\ -\ \underline{419} \\ 3717 \end{array}$	
5. Subtraction with Money		
The student should be able to:		
a. make change readily for specific amounts of money		
b. apply the algorithm to solve problems involving money	Oral work should be encouraged where children make change.	—real money —play money —fliers —catalogues
c. solve money problems involving up to 4 digits		
6. Rounding Off for Estimation		
The student should be able to:		
— round off numbers to 10's, 100's and 1000's and estimate the difference	Children subtract rounded-off numbers to arrive at an estimated difference. This estimated difference is a means of checking to see if the answer given is reasonable. e.g.. $\begin{array}{r} 78 \\ -\underline{51} \end{array}$ $\begin{array}{r} 80 \\ -\underline{50} \\ 30 \end{array}$ (estimate) $\begin{array}{r} 78 \\ -\underline{51} \\ 27 \end{array}$	—number line

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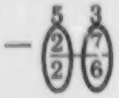
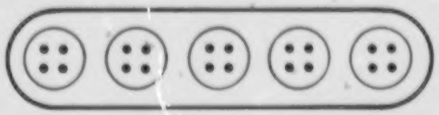
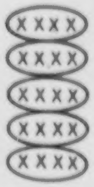
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
7. Checking Subtraction **The student should be able to:** **— use the inverse property to check answers in subtraction**	53 − 27 = 26 26 + 27 = 53 (inverse) 	
8. Word Problems **The student should be able to:** **— use number sentences to solve word problems (one-step)**	Tom had 87 marbles in the bag. He loses 43 marbles to Bill. How many marbles does Tom have left? 87 — 43 = ☐ or 87 — 43 = n etc. See section on problem solving.	—use concrete materials and picture representation to illustrate problems
Multiplication and Division **C. Multiplication** **1. Number Sentence** **The student should be able to:** **— illustrate concretely or pictorially the meaning of a multiplication number sentence** 307	The meaning of multiplication can be reviewed by having the students join equivalent sets and record their work as repeated addition. Examples:  a. 4 + 4 + 4 + 4 + 4 = 20 5 × 4 = 20 b. draw arrays  5 fours = 20	—graph paper —counters —string —number line —pipe cleaners —overhead projector 308

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

2. Basic Facts

The student should be able to:

a. recall with proficiency basic multiplication facts with products up to 40
b. recall with reasonable speed and accuracy, basic multiplication facts between 40 and 100

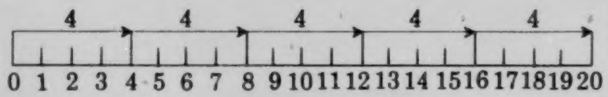
3. Multiplying by 10's, 100's and 1000's, and Their Multiples

The student should be able to:

– multiply a number by 10's, 100's, and 1000's, and other multiples of 10

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

c. number line



5 fours = 20

Use games and activities to reinforce the facts and to provide the necessary drill.

e.g., Product Grid

FOLD HERE

9	9	18	27	36	45	54	63	72	81
8	8	16	24	32	40	48	56	64	72
7	7	14	21	28	35	42	49	56	63
6	6	12	18	24	30	36	42	48	54
5	5	10	15	20	25	30	35	40	45
4	4	8	12	16	20	24	28	32	36
3	3	6	9	12	15	18	21	24	27
2	2	4	6	8	10	12	14	16	18
1	1	2	3	4	5	6	7	8	9
×	1	2	3	4	5	6	7	8	9

FOLD HERE

Multiplying by 10's, 100's, and 1000's orally should be greatly emphasized as this will be a real asset when working with the metric system (decimal).

e.g.,

$$\begin{array}{r} 56 \\ \times\ 100 \\ \hline 5600 \end{array} \qquad \begin{array}{r} 100 \\ \times\ 10 \\ \hline 1000 \end{array}$$

—relate to division
—prerequisite skill for long division

SUGGESTED MATERIALS

Use the following materials for skills 1 to 4:
—numbered cubes
—number line
—hundred chart
—individual hundred charts (dittoed)
—arrays
—flashcards
—counters
—Dienes blocks
—geoboard
—balance beam
—Cuisenaire rods
—egg cartons
—games: "Tuf", "Heads Up", "The Winning Touch"
—product grid
—bean sticks

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. Mathematical Properties **The student should be able to:**		
a. apply the commutative property to multiplication	a. commutative: 3 × 6 = 6 × 3	—bean sticks
b. apply the associative property to multiplication	b. associative: $(2 \times 3) \times 4 = 2 \times (3 \times 4)$	—counters
c. apply the distributive property to multiplication	c. distributive: $8 \times 27 = (8 \times 20) + (8 \times 7)$ $= 160 + 56$ $= 216$ $\begin{array}{r} 27 \\ \times\ 8 \\ \hline 56 \\ 160 \\ \hline 216 \end{array}$ $\quad \begin{array}{r} 27 \\ \times\ 8 \\ \hline 216 \end{array}$	—counters
d. apply the property of "zero" in multiplication	d. $7 \times 0 = 0$	
e. apply the property of "one" in multiplication	e. $7 \times 1 = 7$ (one is the identity element or number of multiplication)	
	TERMINOLOGY SHOULD NOT BE STRESSED	
5. Multiplication with Regrouping **The student should be able to:**	Review multiplication without regrouping.	
a. regroup using expanded notation	Step 1: $\begin{array}{rl} 24 = & 2 \text{ tens} + 4 \text{ ones} \\ \underline{\times\ 3} \quad & \underline{\qquad \times\ 3 \qquad} \\ & 6 \text{ tens} + 12 \text{ ones} = 6 \text{ tens} + 1 \text{ ten} + 2 \text{ ones} \\ & \qquad = 7 \text{ tens} + 2 \text{ ones} \\ & \qquad = 72 \end{array}$ Step 2: $\begin{array}{rl} 24 = & 20 + 4 \\ \underline{\times\ 3} \quad & \underline{\ \times\ 3\ } \\ & 60 + 12 = 70 + 2 = 72 \end{array}$	
b. regroup using the place value grid	Step 3: $\begin{array}{c\|l} T & O \\ \hline 2 & 4 \\ \times & 3 \\ \hline 1 & 2\ (3 \times 4) \\ 6 & 0\ (3 \times 20) \\ \hline 7 & 2 \end{array}$	
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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. regroup using the algorithm	Step 4: Short algorithm $\begin{array}{r} {}^{1}24 \\ \times\ \underline{3} \\ 72 \end{array} \longrightarrow \begin{array}{r} 24 \\ \times\ \underline{{}^{1}3} \\ 72 \end{array} \longrightarrow \begin{array}{r} 24 \\ \times\ \underline{3} \\ 72 \end{array}$ The examples explain the algorithm by means of expanded notation. The children should be allowed to use the *short* algorithm as soon as they are ready to do so.	
6. **Multiplication of Whole Numbers** The student should be able to: — multiply whole numbers up to a 4-digit factor by a 2-digit factor	e.g. $\begin{array}{r} 4\,132 \\ \times\quad 35 \\ \hline 20\,660 \\ 123\,960 \\ \hline 144\,620 \end{array}$	
7. **Multiplication with Money** The student should be able to: a. multiply given amounts of money concretely b. apply the algorithm to solve problems involving money c. solve "money problems" involving up to a 4-digit factor by a 2-digit factor	Select problems that are meaningful to children. It is advisable to introduce multiplication involving money by using repeated addition to justify the place of the decimal point.	—catalogues —play store —real money —play money —cash register receipts
8. **Rounding Off for Estimation** The student should be able to: — round off numbers to 10's, 100's, and 1000's to estimate the product	$\begin{array}{r} 23 \\ \times\ \underline{38} \end{array}$ Estimate $\begin{array}{r} 20 \\ \times\underline{40} \end{array}$ Encourage mental calculation.	

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
9. Checking Multiplication		
The student should be able to:	Encourage the child to estimate first, then compare the computed answer with the estimated answer.	
a. compare the computed answer to the estimated answer	$\begin{array}{r}48\\ \times 12\\ \hline \square\end{array} \longrightarrow \begin{array}{r}50\\ \times 10\\ \hline 500\end{array} \longrightarrow \begin{array}{r}48\\ \times 12\\ \hline 576\end{array}$ Mental Arithmetic	
b. apply the commutative property as a check	$\begin{array}{r}74\\ \times 38\\ \hline 2812\end{array} \longrightarrow \begin{array}{r}38\\ \times 74\\ \hline 2812\end{array}$	
10. Word Problems		
The student should be able to:		
— use number sentences to solve one-step word problems	Six cars went to Clear Lake. Each car held five people. How many people went to Clear Lake? $6 \times 5 = \square$ $6 \times 5 = n$ EXTENSION: Use number sentences to solve two-step problems.	
D. Division		
1. Number Sentence		
The student should be able to:	The meaning of division can be reviewed by having the students find the number of equivalent subsets in a given set and may be expressed as repeated subtraction.	—counters —number line —hundred chart —games, e.g., "The Winning Touch" —travel on leftovers — game —"Krypto" —"Top This"
— illustrate concretely and pictorially the meaning of a division number sentence	a. $32 \div 8 = 4$ $\quad \begin{array}{r}32\\ -8\\ \hline 24\\ -8\\ \hline 16\\ -8\\ \hline 8\\ -8\\ \hline 0\end{array}$ Since 8 was subtracted four times, there are four 8's in 32.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. inverse of multiplication 32 ÷ 8 = ☐ $\boxed{4}$ × 8 = 32 c. missing factor ☐ × 8 = 32	—counters —containers
2. Division Formats The student should be able to: — recognize, interpret, and apply different division formats	e.g., $4\overline{)8}^{\,2}$ or 8 ÷ 4 = 2 or $\frac{1}{4}$ of 8 = 2 or $\frac{8}{4} = 2$	
3. Estimating Quotients and Partial Quotients The student should be able to: — estimate partial quotients and quotients as 10 or multiples of 10	ten as a partial quotient → multiples of ten as a quotient → multiples of ten as a partial quotient → remainder on a shelf $\begin{array}{r\|l} 18 & \\ 3\overline{)54} & \\ 30 & 10 \\ \hline 24 & \\ 24 & 8 \\ \hline 0 & 18 \end{array}$ $\begin{array}{r\|l} 20 & \\ 3\overline{)60} & \\ 60 & 20 \\ \hline 0 & 20 \end{array}$ $\begin{array}{r\|l} 25 & \\ 3\overline{)75} & \\ 60 & 20 \\ \hline 15 & \\ 15 & 5 \\ \hline 0 & 25 \end{array}$ $\begin{array}{r\|l} \underline{2} & \\ 29 & \\ 3\overline{)89} & \\ 60 & 20 \\ \hline 29 & \\ 27 & 9 \\ \hline 2 & 29 \end{array}$ $\begin{array}{c\|c} T & O \\ \hline 2 & 9\ \underline{2} \\ 3\overline{)8} & 9 \\ 6 & 0 \\ \hline 2 & 9 \\ 2 & 7 \\ \hline & 2 \end{array}$ Children should be allowed to use the standard algorithm as soon as they are ready to do so.	
4. Division of Whole Numbers The student should be able to: a. divide up to a 3-digit dividend by a 1-digit divisor, without remainder	*Suggested approach leading up to the standard algorithm might be:*	

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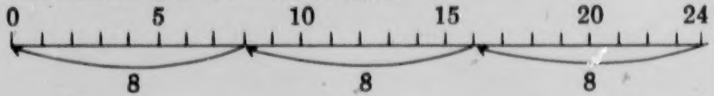
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
[illegible]de up to a 3-digit dividend by a 1-digit divisor, with remainder	See below	

Step 1 — Repeated Subtraction

$$\begin{array}{rrl}
 & 24 & \\
- & 8 & \underline{\qquad} \\ \cline{2-2}
 & 16 & \\
- & 8 & \underline{\qquad} \\ \cline{2-2}
 & 8 & \\
- & 8 & \underline{\qquad} \\ \cline{2-2}
 & 0 &
\end{array}$$

This could be illustrated with concrete materials and/or with the number line (as illustrated).



Step 2 — *Scaffold* *Pyramid*

$$\begin{array}{rr|l}
 & 31 & \\ \cline{2-2}
8 \big) & 248 & \\
 & 80 & 10 \\ \cline{2-2}
 & 168 & \\
 & 80 & 10 \\ \cline{2-2}
 & 88 & \\
 & 80 & 10 \\ \cline{2-2}
 & 8 & \\
 & 8 & 1 \\ \cline{2-3}
 & 0 & 31
\end{array}
\qquad \textit{OR} \qquad
\begin{array}{rr}
 & 31 \\ \cline{2-2}
 & 1 \\
 & 10 \\
 & 20 \\ \cline{2-2}
8 \big) & 248 \\
 & 160 \\ \cline{2-2}
 & 88 \\
 & 80 \\ \cline{2-2}
 & 8 \\
 & 8 \\ \cline{2-2}
 & 0
\end{array}$$

Step 3

$$\begin{array}{rr|l}
 & 31 & \\ \cline{2-2}
8 \big) & 248 & \\
 & 240 & 30 \\ \cline{2-2}
 & 8 & \\
 & 8 & 1 \\ \cline{2-3}
 & 0 &
\end{array}$$

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Step 4 — Standard Algorithm (this should be the *DESIRED FORM* for long division) $\begin{array}{r} 31 \\ 8\overline{)248} \\ \underline{240} \\ 8 \\ \underline{8} \\ 0 \end{array}$ Some students should gradually be directed to the "*short division*" algorithm as they gain competence with estimation, division, and multiplication facts. $\begin{array}{r} 27^{1} \\ 8\overline{)217} \end{array}$ NOTE: A good way of recording the remainder is by placing the remainder on a "shelf", i.e., $\begin{array}{r} 3^{\underline{2}} \\ 3\overline{)11} \end{array}$ EXTENSION: Divide a 4-digit dividend by a 1-digit divisor with and without a remainder	
5. Division with Money The student should be able to: — divide an amount of money where: a. there is no remainder b. the digits do not exceed a 3-digit dividend by a 1-digit divisor with and without remainders	Situations should be created which involve interesting money problems. Where possible, students should use play money or real money. Many exercises should involve changing dollars to cents. e.g., \$1.15 ⟶ 115¢	—real money —play money
6. Division with 10 or its Multiples The student should be able to: — divide where the divisor and the dividend are 10 or multiples of 10	$\begin{array}{r} 3 \\ 30\overline{)90} \end{array}$ Oral proficiency should be encouraged.	

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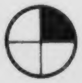
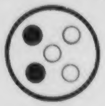
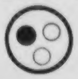
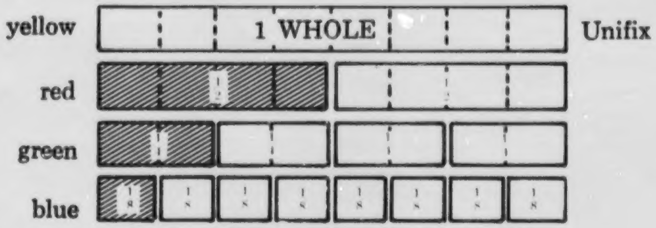
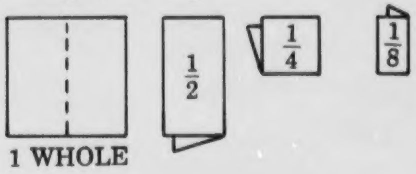
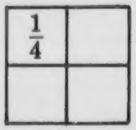
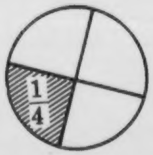
Concepts and Skills are indicated in Bold Face.

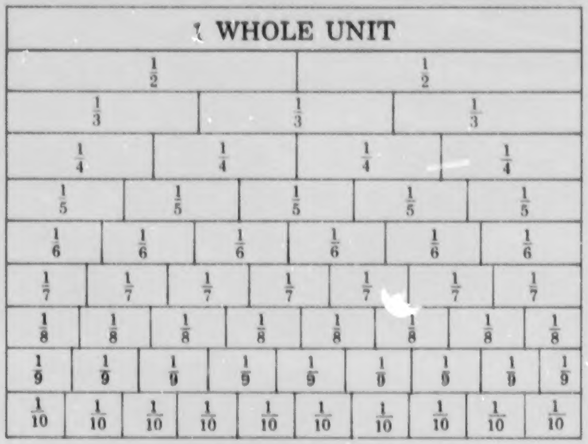
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
7. Rounding Off for Estimation The student should be able to: – round off numbers to 10's or 100's to estimate the quotient	$4\overline{)82} \longrightarrow$ round off to $\longrightarrow 4\overset{20}{\overline{)80}}$ ← estimated quotient Encourage the child to estimate first, then compare the computed answer with the estimated answer.	—number line
8. Checking Division The student should be able to: – use the inverse property (multiplication) to check answers in division	$183 \div 3 = 61$ inverse $61 \times 3 = 183$	
9. Word Problems The student should be able to: – use number sentences to solve one-step problems	There are 48 cards in a particular game. There are 4 players. How many cards will each player receive if all the cards are used? $48 \div 4 = n$ $n = 12$ cards EXTENSION: Use number sentences to solve two-step problems.	
V. **FRACTIONS AND DECIMALS** **A. Fractions** **1. Meaning of a Fraction** The student should be able to: a. illustrate concretely or pictorially the meaning of a fraction 323	The meaning of fractions should be illustrated as: a. *part of a whole*  1 of 4 parts is shaded $\left(\frac{1}{4}\right)$	—pie plates —counters —straws —gum sticks —licorice —Dienes blocks

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. *part of a group*  2 of the total (5) objects are shaded $\frac{2}{5}$ Using a variety of models will lead to a better understanding of the concept. EXTENSION: Recognize the existence of a ratio in the model of a set.  1 out of three 1 : 3	—fraction strips —Unifix blocks
b. understand the meaning of numerator and denominator	The teacher should use the terms regularly so that the student will become familiar with them. Most students will adopt the terms readily.	
c. illustrate concretely, pictorially, and symbolically the meaning and relationship of the following fractions: **— halves** **— thirds** **— fourths** **— fifths** **— tenths**	Activities using concrete material to illustrate common fractions such as $\frac{1}{2}, \frac{1}{3}, \frac{2}{3}, \frac{1}{4}$, etc., $\frac{1}{10}, \frac{2}{10}$, etc. NOTE: It is strongly recommended that we use the format $\frac{1}{4}$ rather than 1/4 as this will facilitate operations and later algebraic concepts, e.g., $\frac{1}{4}+\frac{2}{4}=\frac{3}{4}$	—egg cartons —fraction strips —plane shapes —folding paper —Cuisenaire rods —drinking straws —flannelboard materials —cardboard plates —counters —coloured cubes —games: "Fraction", "Dominoes", "Concentration" (matching game)

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Equivalent Fractions **The student should be able to:** **— illustrate equivalence of fractions using concrete and semi-concrete models**	*Concrete Models:* A variety of models should be used to illustrate equivalent fractions. Cuisenaire rods, Unifix blocks (applied as in fraction charts), plasticine models, paper folding, and fraction bars are some examples to consider.	—Vistrum Fraction Compacts
	a. Unifix, plasticine, fraction bars  Each fractional section should be a different colour.	—Unifix cubes —plasticine —fraction bars
	b. Paper Folding  NOTE: These must be opened up to illustrate the fractions!	—heavy paper
	Semi-Concrete The area region (geoboard, graph paper) and fraction chart are just two methods to illustrate equivalent fractions at this level.   	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	 1 WHOLE UNIT 1/2 1/2 1/3 1/3 1/3 1/4 1/4 1/4 1/4 1/5 1/5 1/5 1/5 1/5 1/6 1/6 1/6 1/6 1/6 1/6 1/7 1/7 1/7 1/7 1/7 1/7 1/7 1/8 1/8 1/8 1/8 1/8 1/8 1/8 1/8 1/9 1/9 1/9 1/9 1/9 1/9 1/9 1/9 1/9 1/10 1/10 1/10 1/10 1/10 1/10 1/10 1/10 1/10 1/10 FRACTION CHART Equivalent fractions may be developed using a metre stick. ENRICHMENT: Change an improper fraction to a mixed number and vice versa. e.g., $2\frac{3}{4} = \frac{7}{4}$	
3. Addition of Fractions The student should be able to: a. illustrate concretely or pictorially addition of fractions with like denominators and yielding sums less than 1 b. illustrate numerically the addition of fractions with like denominators and yielding sums less than 1	e.g., $\frac{2}{10} + \frac{7}{10} = \frac{9}{10}$ In the example, the unit fraction $\frac{1}{10}$ should be well defined and understood. This of course, can be developed as in #1. The students should be given opportunities to cut and paste, shade areas, etc., in illustrating addition of fractions.	—metre stick —metric containers —coloured cubes as part of a set of cubes —pie plates and geometric plane shapes —number line 0 to 1, and/or 1 to 10 (cr

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Concepts and Skills are indicated in Bold Face.

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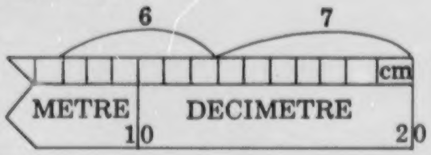
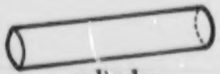
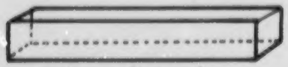
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	EXTENSION: Illustrate concretely, pictorially and numerically the addition of fractions with like denominators and yielding sums greater than 1. This may be illustrated with Unifix blocks, fraction bars, metre sticks, etc. Metre Stick  $\frac{7}{10} + \frac{6}{10} = \frac{13}{10} = 1\frac{3}{10}$	
4. Subtraction of Fractions The student should be able to: a. illustrate concretely and pictorially subtraction of proper fractions with like denominators	This can be developed in a similar manner as that used for addition.	—number line —pie plates —cubes —chocolate bar —0-1 number line showing fractions —overhead projector with appropriate transparencies of 1 as being $\frac{4}{4}$, $\frac{3}{3}$, $\frac{8}{8}$, etc.
b. illustrate numerically the subtraction of proper fractions with like denominators		
c. illustrate concretely, pictorially, and symbolically, subtraction of a proper fraction from the whole number 1	$1 - \frac{3}{4} = \frac{1}{4}$ The unit can be thought of as having to be divided into fourths and taking three-fourths out of it. An actual situation will help to develop the idea of renaming 1 by an equivalent fraction directly related to the fraction to be subtracted.	
B. Decimals **Decimal Notations** The student should be able to: – express fractional parts $\frac{1}{10}$'s, $\frac{1}{100}$'s to two-decimal places	Decimal notation in the metric system should be introduced *informally* and compared to our monetary system.	—metre stick —currency —money

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	m dm cm — 1 2 5 1 m and 2 dm and 5 cm ↓ 1 m and 20 cm and 5 cm ↓ 1 m and 25 cm ↓ 1.25 dollars dimes cents — 1 2 5 ↓ 1 dollar and 2 dimes and 5 cents ↓ $1 and 20 cents and 5 cents ↓ $1 and 25 cents ↓ $1.25 EXTENSION: Exemplify concretely, pictorially, and symbolically the addition and subtraction of two-place decimals as related to metric measure and money.	
VI. GEOMETRY **A. Shape Awareness** The student should be able to: 1. recognize 3-D shapes (solid) in the environment 2. recognize 2-D shapes (plane) in the environment	Have a "Shape Day": children bring everyday objects which are shaped like a cylinder, a cube, a rectangle, a prism, etc. Classify the objects into sets for similarities or differences. Trace the faces of the solid shapes and identify the plane shapes. Make a 3-D mobile in art class.	—set of solid geometric models —variety of interesting objects from the environment, e.g., boxes, calendar tubes, ball, drinking cup, etc.
B. Solid Shapes The student should be able to: 1. identify the following solids in the environment and from man-made models: — cube — cone — sphere — cylinder — pyramid — rectangular prism (cuboid) — triangular prism	cube cone sphere  cylinder pyramid  rectangular prism triangular prism	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Identify more than one shape in structures. For example, a metal grain bin has the shape of a cylinder and a cone; a house may be a combination of shapes such as a rectangular prism, triangular prism, etc.	—models of solids
2. combine (concretely) the shapes in #1 to build new shapes	Build structures by combining two or more solid shapes. This should be an informal activity.	—straws, pipe cleaners or plasticine —wire —attribute blocks —manilla patterns (nets) of 3-D and 2-D shapes —construction paper
3. determine the number of faces, straight edges, and corners on a solid geometric shape	Using "solid models" or facsimiles, explore their structure, number of faces, etc. Make a chart to record the findings.	—set of solid models —styrofoam models, or shapes of everyday objects

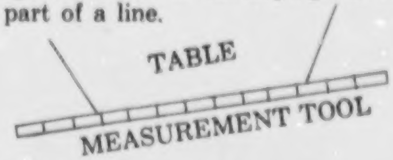
Name of Solid	No. of Faces	No. of Corners	No. of Edges
rectangular prism	6	8	12
triangular prism	5	6	9
pyramid	5	5	8

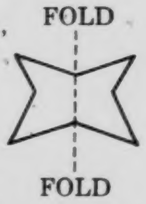
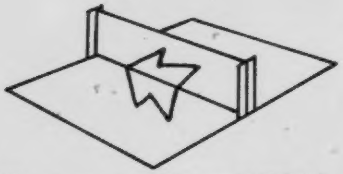
C. Line Segment

The student should be able to:

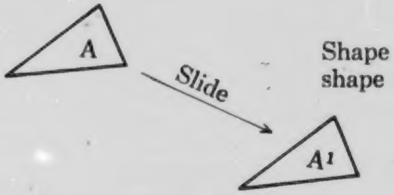
— relate a line segment to linear measurement

The line segment should be approached through measurement. Measuring the edge of a table, for instance, is an exercise that will illustrate the idea of a line segment (due to the fact that the straight edge of the table has a starting point and an end point). Using a measuring tool longer than the table edge will assist in developing the idea that a line segment is part of a line.



CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Congruent Plane Shapes The student should be able to: – test at least two plane shapes for congruence	Shapes must be identical in all respects to be congruent. Make a congruent model of a plane shape by tracing or by paper folding. A model constructed on the geoboard could also be reconstructed on graph paper. Be sure that the size of the reconstructed model is the same as the original model. Test two plane shapes for congruence by tracing, matching, and/or measuring with a ruler. Application of congruency in shapes is most enjoyable when integrated in other areas such as art. For potato printing, for example, cut a shape to make a design for wallpaper or book covers.	—tissue paper —waxed paper —geoboard (square centimetre) —graph paper (square centimetre) —geopaper (dot paper) —models for tracing —paint —potato
E. Symmetry The student should be able to: – find the lines (axes) of symmetry and the existence of two congruent halves in certain triangles, circles, squares, and rectangles	Regular plane shapes should be explored for lines of symmetry. Students will find that some shapes have more than one line of symmetry, while others will have no lines of symmetry. Students may use the transparent mirror (MIRA), or paper folding or cutting to find the lines of symmetry. e.g.,  *Paper Folding*  *Transparent Mirror* (MIRA) The image will be congruent to that of the shape *behind* the "mirror". A chart could be made to record the findings. Symmetry should also be observed and identified in natural objects, such as animals, leaves, art, etc.	—tissue paper —waxed paper —construction paper —grid paper —geopaper (dot paper) —geoboard —MIRA

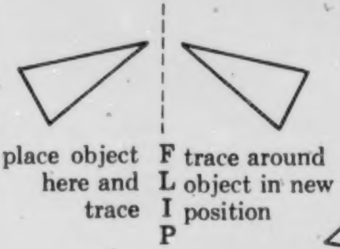
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
F. Angles		
The student should be able to:		
— identify angles as either being right angles (square angles) or non-right angles	Construct right or square angles by paper folding. Use a square or rectangular shape to check. Identify right angles on solid shapes. For example, children could find the right angles seen in the room. Angles other than the right angle can be folded and compared as being larger or smaller than the right angle. Names of other angles (acute, obtuse, etc.) should *not* be stressed.	—waxed paper —solid shapes —plane shapes
G. Slides, Flips and Turns		
The student should be able to:		
a. change the location of an object (shape) by: — a slide — a flip — a turn	See the notes on program implementation for an explanation of slides, flips and turns.	—mirrors —MIRA —plane shapes —gymnastic materials —student movement education — physical education guide —geoboard —geopaper
b. state what motion was used to effect a change	*Slides* may be illustrated by tracing and sliding a shape (in any direction) from one position to another. Waxed paper is particularly effective for this activity. Trace this shape.  Shape A^1 should be congruent to shape A.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

Flips may be illustrated by placing an object (shape) on a piece of paper, tracing around the object, flipping it over a line, and tracing around the object in its new position. Other techniques involve the transparent mirror (MIRA), and the geoboard.


place object here and trace
FLIP
trace around object in new position

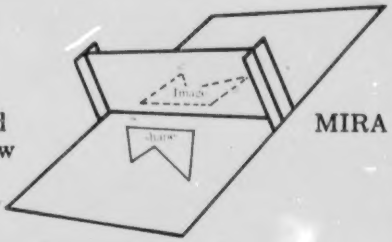
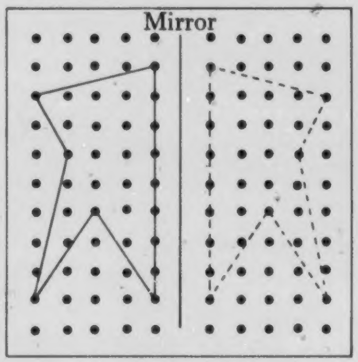


Image
shape
MIRA

GEOBOARD



Record the experiences on geopaper.

Another illustration for a flip could be:

a. fold a piece of waxed paper.
b. draw an image on one side making certain to apply pressure to create an image on the other side.
c. open the sheet of paper to reveal a flipped image.
d. correlate with symmetry.

A mirror held vertically will reflect the object.

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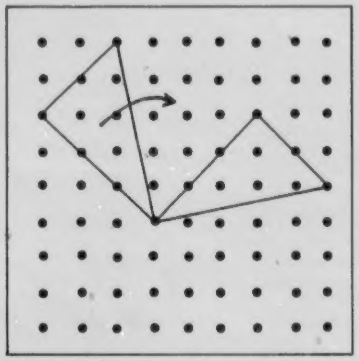
CONCEPTS, SKILLS AND OBJECTIVES

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

SUGGESTED MATERIALS

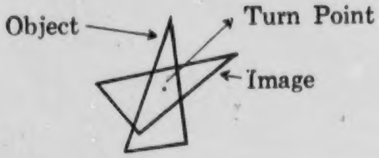
Turns can be illustrated by tracing around an object on a piece of paper, turning it around a pivot on, within or outside the shape, and tracing around the object in its new position. A geoboard and/or geopaper will also provide a good illustration of turns.

on a vertex

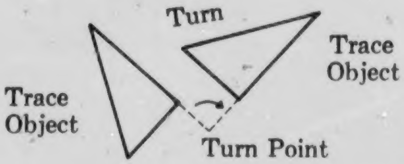


EXTENSION:

a. on a point within


Object
Turn Point
Image

b. on a point outside


Turn
Trace Object
Trace Object
Turn Point

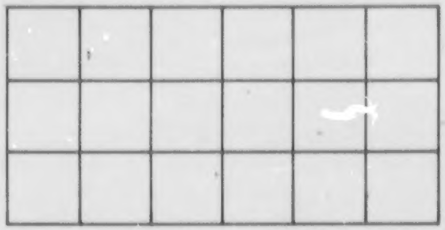
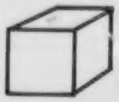
Application of slides, flips and turns can be found in designs. Have children design wallpaper pattern, cloth, and book covers.

Concepts and Skills are indicated in Bold Face.

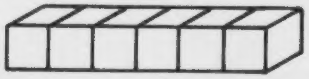
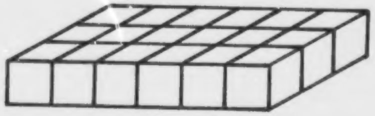
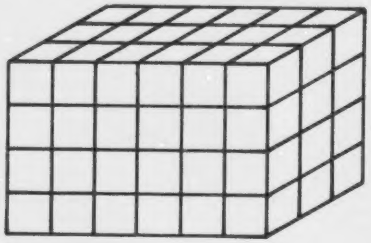
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VII. MEASUREMENT **Readiness for Metric Measure** 345	1. Since estimation plays an important role in the development of the concept of measurement, students should always be encouraged to estimate first before finding the exact measurement. 2. Students will first measure with non-standard units and later with the appropriate standard metric units. 3. Children should learn to use these terms as much as possible. They should be involved in vocabulary related to their social experiences, e.g., I weigh 40 kilograms. (In everyday life, mass and weight are often used interchangeably.) 4. *Do not convert* from the present Imperial system, use the new unit for measuring. However, there are times when it might be helpful to compare the new unit to the known unit, e.g., a litre is a little smaller than a quart. 5. Measurement should not be treated as an isolated unit of learning, but it should be a continuous learning experience throughout the year. 6. The textbook you are using may not have a full metric program and you might need supplementary material. 7. Most of the activities should be done in small groups so that each pupil may participate.	346

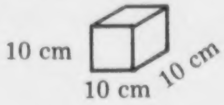
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
A. Linear Measure **The student should be able to:**		
1. **recall the concepts of metre, decimetre, and centimetre with measurement activities** 2. **become familiar with the kilometre**	Real measuring experiences provide a good opportunity to review or to re-teach previous material. For example, find the distance of 1 kilometre by measuring around the school yard, using metric surveyor tape (the 100 metre rope used ten times).	—metre sticks —tape measures —ropes cut into 10 metre lengths —20 centimetre ruler —rope (100 metres long) —metric trundle wheel —Cuisenaire rods —micrometer —calipers —odometer
3. **add and subtract linear measures without and with regrouping**	*Without regrouping* $\begin{array}{r}2\text{ m}\quad 45\text{ cm}\\ +5\text{ m}\quad 23\text{ cm}\\ \hline\end{array} \rightarrow \begin{array}{r}2.45\text{ m}\\ +5.23\text{ m}\\ \hline 7.68\text{ m}\end{array}$ Children should be made aware of the similarity in structure of metric measures and the decimal number structure. *With regrouping* $\begin{array}{r}6\text{ m}\quad 30\text{ cm}\\ +3\text{ m}\quad 75\text{ cm}\\ \hline 9\text{ m}\quad 105\text{ cm}\\ 10\text{ m}\quad 5\text{ cm or } 10.05\text{ m}\end{array}$ or preferably $\begin{array}{r}6\text{ m}\quad 30\text{ cm}\\ +3\text{ m}\quad 75\text{ cm}\\ \hline\end{array} \longrightarrow \begin{array}{r}6.30\text{ m}\\ +3.75\text{ m}\\ \hline 10.05\text{ m}\end{array}$	
4. **select the appropriate unit for estimating and measuring length**	It is essential that students learn to select the appropriate unit for measuring length, e.g., cm or m.	
5. **estimate and measure the perimeter of objects and shapes in metres and centimetres**	Use regular and irregular shapes (no formula required).	
B. Area **The student should be able to:**		
1. **recall the concept of cm² by construction and measurement**	Transparency grids in cm² are very useful to measure the area of surfaces of a variety of geometric shapes.	—squared paper (cm²) —geometric shapes —geoboards

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. **determine the area of a rectangle**	Place geometric shapes on squared paper; trace and determine area covered in square units. Students may discover a shortcut to find area when counting units takes too long, i.e., a rectangle has $6\ cm^2$ along one side; there are 3 rows of $6\ cm^2$. So $3 \times 6 = 18\ cm^2$ 	—overhead projector —transparency grid in square centimetres
3. **construct a square metre (m^2)**	The square metre can be constructed out of paper.	—1 metre square showing subdivision in decimetres and centimetres
4. **select the appropriate unit for estimating and measuring areas**	It is essential that children learn to select the appropriate unit for measuring larger areas, and see how difficult it would be to measure larger areas, for instance, the school hall in square centimetres. To reinforce these concepts, decide together which square unit would be most suitable to measure the area of: the classroom, the gym, the pupil's desk, a box lid, etc.	
C. Volume (No Formula)		
The student should be able to:		
1. **recall the concept of volume with constructions and models**	Structures are built with one centimetre cubes. The number of cubes gives the volume.  The standard unit of volume is cm^3.	—centimetre cubes (Cuisenaire white rods)

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. determine volume by cubic centimetre (cm^3)	Structures are built: a. of rows of cubic units.  e.g., a row of 6 cm^3 b. of one layer (several rows) of cubic units.  e.g., one layer of 3 rows of 6 cm^3 in each row c. of several layers of cubic units.  e.g., 4 layers of 3 rows in each layer and 6 cm^3 in each row	—cubic centimetres (cm cubes) —centimetre squared graph paper

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. construct a cubic metre (m^3)	A cubic metre can be constructed out of 12 sheets of rolled newspaper (1 metre long), securely taped, and the corners held together with wire. This will make the frame of 1 cubic metre.	—newspaper —hose with wooden cores —commercial cubic metres are also available
4. construct a cubic decimetre (dm^3)	Make a model of a dm^3.	—if sufficient Cuisenaire rods are available, ten rows of ten orange rods will make a cubic decimetre — commercial cubic decimetres are also available
5. select the appropriate unit for estimating and measuring volume	The student should be able to select the unit of volume — m^3, dm^3, cm^3 — to most efficiently measure a given volume.	
D. Capacity		
The student should be able to:		
1. recall the concept of litre (ℓ) by constructing and measuring	A set of containers of varied shapes and sizes (tin cans, bottles, juice cans, etc.) should be ordered from small to large, first by estimating and then by measuring using the litre.	—juice cans and other containers — a one-litre container can be made from a 2-quart milk carton 
2. measure the relationship of the millilitre (ml) and the litre (ℓ)	The same activities as for D 1 could be undertaken using small containers in addition to the larger ones.	—plastic pill boxes —soap bottles —measuring spoons —syringes —eye droppers
3. select the appropriate unit for estimating and measuring capacity		
4. estimate and measure capacity		
5. add and subtract capacity measures without and with regrouping		

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Mass The student should be able to:		
1. **estimate and measure the weight of an object in kilograms (kg)**	At this point the children should have become familiar with the prefix "kilo" as it is used in kilometre and kilogram, and should begin to realize the relationship of kilometre to metre, and kilogram to gram, where "kilo" means *one thousand*. The students could find their own weight.	—make one kilogram weights using plasticine, rocks, one kilogram bean bag —sawdust —grain —various objects —balance scales —commercial masses
2. **estimate and measure the weight of an object in grams (g)**		
3. **select the appropriate unit for measuring mass**		
F. Money The student should be able to:		
— **solve money problems in addition, subtraction, multiplication and division**	See section IX D, for comments on problems in addition, subtraction, multiplication and division, and on unit pricing.	—newspaper ads
G. Time 1. **Elapse of Time** The student should be able to:		
a. estimate the time needed for doing a certain task	Activities relating to time in the life of the student are plentiful.	
b. compare the estimated time for doing a certain task to the known time required for another task	What task can the child complete in a minute? Estimate, compare and measure such tasks as putting on shoes, running around the school or school yard, etc. Compare the time needed for certain activities such as brushing teeth, eating breakfast, trip to grandparents, to activities of a known time length such as length of recess, a class period, church service, favourite television program, etc.	
c. measure the time needed for doing a certain task		

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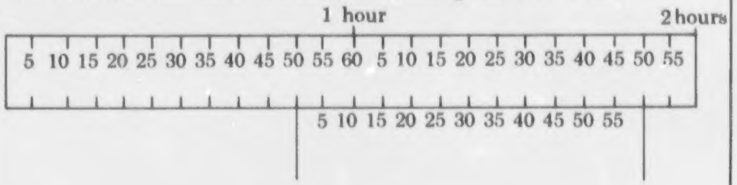
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Time Related to Clocks		
The student should be able to:		
a. read a clock to the nearest minute		—clocks
b. read time in two ways	12 40 may be read as twelve forty or as 20 minutes to one.	
c. relate and use a.m. and p.m. to time	A twenty-four hour clock could be introduced here, e.g., 2 30 p.m. or 14 30.	
	Activities in which the children relate an event in the day to time — Saturday television: give favourite program and time (a.m. — p.m.).	—television guides
d. change minutes to hours and vice versa	e.g., 50 minutes + 20 minutes = 70 minutes = 1 hour and 10 minutes.	
e. add and subtract units of time	This can be worked out on a special number line. It will consist of a line of two units of 60 each, divided into 5-minute intervals. A separate similar strip equally divided into 5-minute intervals can be placed above or below the number line to find the answer. Subtraction can also be illustrated using the two aids.  1 hour 2 hours 5 10 15 20 25 30 35 40 45 50 55 60 5 10 15 20 25 30 35 40 45 50 55 5 10 15 20 25 30 35 40 45 50 55	
3. Units of Time		
The student should be able to:		
a. state the number of hours in a day		—clocks
b. state the number of days in a week, month, year		—calendar
c. state the number of weeks and months in a year		

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
H. Temperature		
The student should be able to:		
– read the Celsius thermometer above and below zero	This area provides an excellent opportunity to integrate mathematics with science in such activities as measuring the temperature of water and ice, body temperature, outdoor and indoor temperature. Keeping a record of daily high or low temperature leads to the construction of a graph.	—Celsius thermometer
VIII. GRAPHING		
Introductory Notes	Although the skills of graphing are usually taught in the mathematics program, the construction and interpretation of graphs may be pursued at a time when it will supplement or reinforce work being done in science, health, reading, and other subjects. An informal approach to graphing has been recommended in the primary grades where emphasis has been on the concrete graph, the pictograph, and the bar graph, with one symbol representing one unit of data. A more structured approach may now gradually be used in the intermediate grades, with the introduction of the line graph.	
A. Steps in Graphing		
The student should be able to:		
1. a. state what they are graphing **b. state why they are graphing**	Children should understand that graphing is a means of pictorially recording data. For example, graph the results of a survey.	—graph paper: chart size, two centimetre squares —rulers —gummed squares for above graph paper
2. gather information of data in a variety of ways	Data may be obtained through measurement activities, surveys, and research. If transportation is studied in social studies the following approach to graphing is suggested. For example, count the number of vehicles passing your school during the day or gather the data.	
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Concepts and Skills are indicated in Bold Face.

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>3. organize the information or data in a useful manner</td><td><i>Tallying</i> — organizing the information collected.
<table>
<tr><th colspan="6">Vehicles Passing School Between 10 00 — 11 00 hours</th></tr>
<tr><th>cars</th><th>trucks</th><th>buses</th><th>bicycles</th><th>Mopeds</th><th>etc.</th></tr>
<tr><td>𝍸 𝍸
||||</td><td>𝍸 |||</td><td>|||</td><td>||</td><td>𝍸 𝍸
|</td><td>|</td></tr>
</table></td><td></td></tr>
<tr><td>4. select a suitable type of graph to illustrate the data</td><td>Which type of graph will be most suitable? The type of graph to be selected will be determined by the nature of the data. Either a pictograph or a bar graph could be suitable for the above data.</td><td></td></tr>
<tr><td>5. select a suitable scale to best illustrate the data on the graph</td><td>Identify the range of data, and the high and low extremes. A point of origin (preferably 0) may then be selected. With this data, and <i>with teacher direction</i>, a suitable scale can be determined. The scale should be stated on the graph. It is important that <i>equal</i> intervals be used for all data on each axis of the graph.</td><td></td></tr>
<tr><td>6. construct the graph</td><td>Construct the graph. The teacher and students can now graph the data obtained.
Care should be taken to label the horizontal and vertical axes, mark the scale, record the data, and provide a suitable title. Emphasize balance and neatness.</td><td></td></tr>
<tr><td>7. draw some conclusions about the data and report and interpret the graph</td><td>Students should draw some conclusions about the data and how it satisfies the original purpose. The conclusions or observations may be reported orally or as a brief, written statement. Word problems can be devised from the data on the graph.</td><td></td></tr>
<tr><td>B. Types of Graphs
1. Concrete
The student should be able to:
a. construct a concrete graph
b. interpret and report on a concrete graph</td><td>See section V in grade 1.</td><td>—concrete objects</td></tr>
</table>

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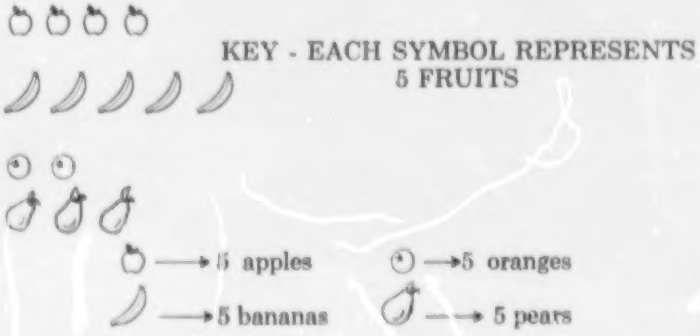
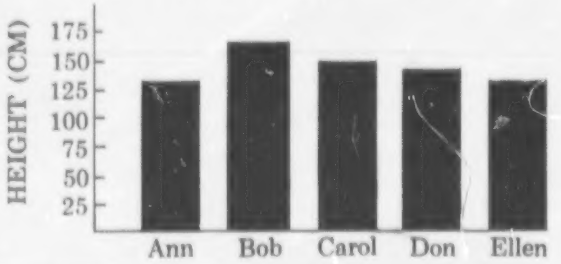
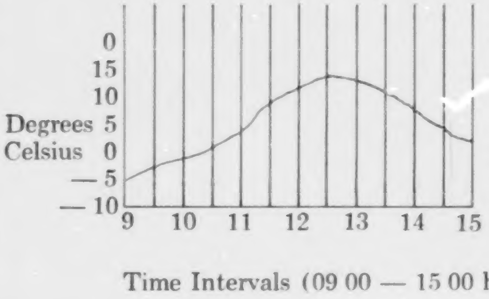
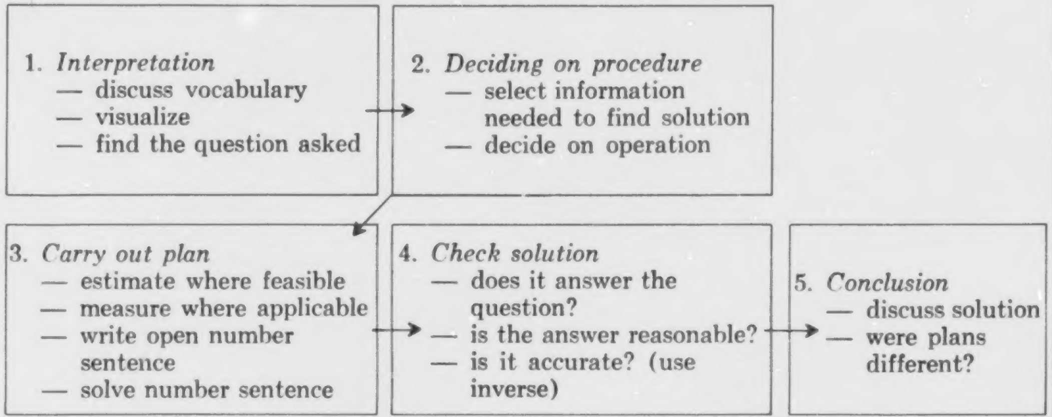
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Pictograph The student should be able to:		
a. construct a pictograph using one symbol for each unit of data or one symbol for more than one unit of data	Review the pictograph using a symbol for each unit of data. Introduce the concept of using a symbol for more than one unit. e.g., Fruits Eaten for Lunch by Students of a Class During a One Week Period  	—gummed seals —magazine cut-outs
b. interpret and report the results illustrated in a pictograph		
3. Bar Graph The student should be able to:		
a. construct a vertical or a horizontal bar graph to represent a set of data	Title: Heights of five students Data: Ann — 135 cm, Bob — 165 cm, Carol — 150 cm, Don — 143 cm, Ellen — 130 cm	—graph paper
b. interpret and report on the results illustrated in the bar graph	 	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. **Line Graph** The student should be able to:		
a. construct a line graph to represent a set of data	See notes on program implementation. A line graph should be used only to report on data which is continuous and which indicates changes or tendencies. e.g., i. graphing high or low temperatures over a period of time. ii. graphing plant growth over a period of time, e.g., bean in earth. NOTE: Integrate with science.	—geoboards —string —graph paper
b. interpret and discuss the results illustrated in a line graph	 NOTE: Weight or height can be shown on a line graph *only* if it is for the same child over a period of time.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
IX. PROBLEM SOLVING		
A. Oral Problems The student should be able to:		
1. **solve simple oral problems quickly and accurately** 2. **explain how they obtained their solution by:** a. using concrete material b. using a diagram c. using a number sentence	Introducing problems at this level could well begin by presenting simple oral problems. where children can find a quick solution and explain how they arrived at the solution — either with material or by a diagram or a number sentence. Small groups lend themselves well to this approach and enable the teacher to quickly detect which children are having difficulties.	
B. One-Step Word Problems The student should be able to:		
1. **solve one-step word problems**	Teacher and children can discuss ways of solving a written problem.	
2. **analyze a problem**	The following steps are suggested as guidelines to problem solving.	



1. *Interpretation*
   - discuss vocabulary
   - visualize
   - find the question asked

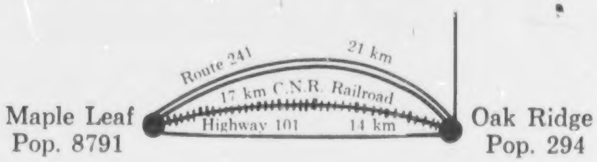
2. *Deciding on procedure*
   - select information needed to find solution
   - decide on operation

3. *Carry out plan*
   - estimate where feasible
   - measure where applicable
   - write open number sentence
   - solve number sentence

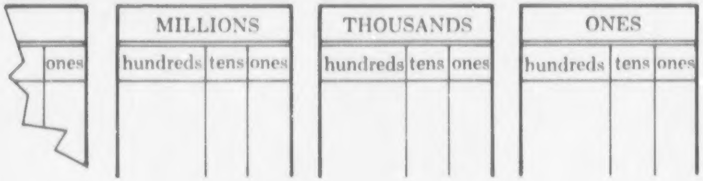
4. *Check solution*
   - does it answer the question?
   - is the answer reasonable?
   - is it accurate? (use inverse)

5. *Conclusion*
   - discuss solution
   - were plans different?

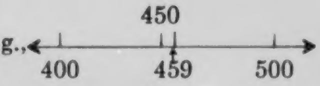
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Suggested Procedure for Problem Solving The student should be able to:		
1. interpret the word problem	The problem is presented and its nature discussed. If certain words appear to be difficult to interpret, another word could be substituted.	
2. illustrate the word problem	To illustrate the problem, you could use concrete material, representative material, or draw a picture or diagram.	
3. decide the procedure for solving the problem	Look for important information which will help to solve the problem. Which words (clues) in the problem help you to decide on the operation?	
4. estimate the solution then complete the procedures (operations) to solve the problem	Estimating is encouraged where it is feasible, by rounding off. For example, to find how far one travelled in two stages of 315 km and 284 km, or 315 + 284 = ☐, quick rounding off will lead to the *mental* calculation of 300 + 300 = $\boxed{600}$. 600 may be recorded, for later reference. — Write the open number sentence. — Solve the number sentence (compute).	—classroom —environment —sports —team statistics (graphing) —ordering supplies
5. check the solution	Does the solution answer the question? Is the answer reasonable when compared with the estimated answer? Is the answer correct? Check by inverse operation if this is not too involved.	
6. write the conclusion in statement form	Write the solution in a brief statement form, e.g., they travelled 599 km. A brief discussion will often lead to the conclusion that some children did not use the same procedure but had the same solution. NOTE: Although the above are suggested steps in teaching problem solving they are by no means a must. They could, however, enable many children to tackle problems in a more meaningful way.	

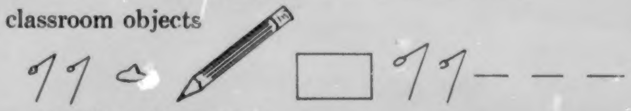
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	EXTENSION: Two-Step Word Problems Oral introduction to simple two-step problems, i.e., two different operations.	
D. Interesting Problem-Solving Activities	Some interesting variations in problems: — Write a story problem on the outside of an envelope. Inside the envelope place a card showing the steps and the answer to the problem. After pupils have worked through the problems, they may check the cards for correctness.	—picture problem cards —word problem cards with easy reading
	— Let pupils make up shopping orders from catalogues and fliers, etc., and then ask them to determine what the cost of their order will be. Or, again referring to the catalogues and fliers, ask them what they would order if given a specific amount of money and why.	—fliers, advertisements, catalogues —menus (for restaurant orders)
	— Write five or six mathematics sentences on the board. Let children make up a word problem for each.	
	— Assign five or six word problems. Ask the class to draw a picture or diagram for each one.	—small (home-made) maps
	— Use a small map (such as the one below) and ask pupils to make up a word problem based on it. Different word problems will probably arise. All should be discussed.  Route 241 21 km 17 km C.N.R. Railroad Highway 101 14 km Maple Leaf Pop. 8791 Oak Ridge Pop. 294 NOTE: The concept of unit pricing could be introduced to develop ability in determining the best buy, e.g., soap — 3 bars for 39¢, 4 for 50¢.	
371		372

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. NUMBER: 7-, 8- AND 9-DIGIT NUMBERS	NOTE: Seven-, eight- and nine-digit numbers are now being introduced formally. Continued emphasis should be placed on the structure of our number system, i.e., the repeating ones, tens, hundreds, in each period.	
	 ones MILLIONS hundreds tens ones THOUSANDS hundreds tens ones ONES hundreds tens ones	
A. Place Value The student should be able to:		
1. **read and write base ten whole numbers up to nine digits including zero as a place holder** 2. **read and write decimals up to three places**	In metric editions of some textbooks the comma has been removed from period groupings, e.g., 54,265 where the comma is replaced with a space, 54 265. This is in compliance with SI metric specifications. Where four digits are used it is not necessary to leave a space, i.e., 4691.	
3. **give the value of any digit in a number**	Activities involving grouping with toothpicks, popsicle sticks, multi-base blocks, place value charts, currency, Cuisenaire rods, Unifix materials, etc., provide concrete experiences to develop the base ten concept. Activity — assign as many as nine pupils in a different place value position. Have them arrange themselves side-by-side according to the place value chart. Then have them hold up fingers (each choosing between 0-9) and get the rest of the class to "read the numeral".	—multi-base blocks —currency —popsicle sticks —coffee stirrers —straws —toothpicks —elastic bands —Dienes blocks —abacus —money —base ten machine
B. Expanded Notation The student should be able to:		
— **write numbers up to 9 digits in expanded notation**	497 632 = 4 hundred thousands + 9 ten thousands + 7 thousands + 6 hundreds + 3 tens + 2 ones OR	

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td></td><td>497 632 = 400 000 + 90 000 + 7000 + 600 + 30 + 2
OR
497 632 = 490 000 + 7000 + 600 + 30 + 2
etc.</td><td></td></tr>
<tr><td>C. Renaming Numbers
The student should be able to:
— rename a number in many ways</td><td>A number can be renamed in many ways, e.g., $36 = 35 + 1 = 4 \times 9 = 30 + 6 = 40 - 4 = 7 \times 5 + 1 = 2 \times 2 \times 3 \times 3 = \frac{1}{2}$ of 72, etc. Place a number on the board and have each student rename it in a different way. This will facilitate the understanding of numbers.</td><td></td></tr>
<tr><td>D. Regrouping Numbers (Renaming by Place Value)
The student should be able to:
— regroup a number in tens</td><td>Regrouping will help the students to understand the processes involved in operations.
e.g., 15 + 18
$\begin{array}{l} \quad 10 + 5 \\ +\underline{10 + 8} \\ (10 + 10) + (5 + 8) \\ \quad 20 + 13 \\ \quad 20 + (10 + 3) \\ \quad 30 + 3 \\ \quad 33 \end{array}$ OR $\begin{array}{r|l} T & O \\ \hline 1 & 5 \\ +1 & 8 \\ \hline 2 & 13 \\ \hline 3 & 3 \end{array}$
$\begin{array}{r|l} T & O \\ \hline 1 & 5 \\ +1 & 8 \\ \hline 1 & 3 \\ +2 & \\ \hline 3 & 3 \end{array}$ OR $\begin{array}{r} 15 \\ +18 \\ \hline 33 \end{array}$
The above example should be used by the teacher to help to explain regrouping but need not be used by the pupils.</td><td>—number line
—counters
—Dienes blocks
—bean sticks
—abacus</td></tr>
</table>

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Rounding Off The student should be able to:		
1. round off whole numbers using any one of the digits in a nine-digit number	*Rounding off to hundreds game:* Assign numbers to students in multiples of 100. Each student writes with crayon his/her number on a large piece of paper. Have the 100's between 500 and 1800 line up in the correct order side-by-side. Assign another student a number, 1059, and have him/her find the right place in front of the nearest 100, which would be 1100. Continue by assigning other numbers to students who then find their right place. The range of multiples of 100's may be changed. The above game may be modified to round off to any other place value. e.g.,  459 to the nearest hundred would be rounded off to 500. Since the above example shows rounding off to the nearest hundred, only the part of the number line between 400 and 500 should be seen by the student. 57 293 ⟶ 57 290 to nearest 10 57 300 to nearest 100 57 000 to nearest 1000 60 000 to nearest 10 000 100 000 to nearest 100 000	—number line
2. round off decimals to any one of three places 378	2.3 to nearest whole number is 2 2.12 to nearest tenth is 2.1 2.137 to nearest hundredth is 2.14 NOTE: When rounding off a "5", the student should be directed to raise it to the higher value, e.g., 15 → 20 (tens), 750 → 800 (hundreds).	379

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
F. Equalities and Inequalities **The student should be able to:** **– use the appropriate symbols (<, =, ≠, >) to make a number sentence true**	$3 + 5 \textcircled{=} 4 + 4$; $8 \times 3 \textcircled{<} 30 - 5$ OR $8 \times 3 \textcircled{\neq} 30 - 5$ Number sentence games are recommended to establish a good understanding of the concepts of equality and inequality, as well as to reinforce these concepts.	—open number sentence cards
II. ROMAN NUMERALS **The student should be able to:** **1. recognize and translate I, V, X, L, C, D and M into Hindu-Arabic or decimal equivalents and vice versa** **2. translate, read and write numbers from I to M applying the appro-riate rules of usage**	The teacher should attempt to make Roman numerals relevant by providing specific examples, i.e., clocks, preface pages, book chapters, etc.	—clocks —books
III. OTHER NUMERATION SYSTEMS	EXTENSION: Relate other numeration systems to our Hindu-Arabic or decimal system. Systems such as the following might be explored: Egyptian, Mayan, Chinese, Greek, Babylonian, etc.	
IV. NUMBER THEORY **A. Patterns** **The student should be able to:** **1. identify, construct, and complete simple patterns using concrete materials**	Please refer to notes on program implementation for discussion on patterns. A brief review of concrete patterns may be necessary. e.g., classroom objects  complete the pattern	—pattern blocks —Unifix cubes —parquetry tiles —beads —bottle tops —buttons —ceramic tiles

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. identify, construct and complete simple pictorial patterns:		—pictures of objects —blocks —spools —straws —pegboards (pegs) —stationery supplies
a. natural	Stellar constellations, life cycle, animal markings, bird migration, tides, moon phases, etc.	
b. man-made	Music (rhythm), art, streets and roads, habits and routine activities, wallpaper, wrapping paper, architecture, etc., geometric activities using symmetry, slides, flips, turns, tessellations (tiling), etc., will provide practice in constructing, identifying, and completing patterns (see geometry).	—road maps —wallpaper —wrapping paper —pictures (architecture) —art paper —plane shape models
c. numerical patterns	Informal discovery sessions should be conducted with the hundred chart. After students have had sufficient practice in finding patterns they should be directed to activities where they have to supply the missing numbers to complete the pattern. This should also be considered when using addition and product grids. Patterns: — count by 2's, 3's, 4's, etc. — successive differences along diagonals, etc.	—graph paper —transparency (grid)

$$\underbrace{3 — 14}_{11} \underbrace{— 25}_{11} \underbrace{— 36}_{11} \underbrace{— 47}_{11} \text{ etc.}$$

$$\underbrace{8 — 17}_{9} \underbrace{— 26}_{9} \underbrace{— 35}_{9} \underbrace{— 44}_{9} \text{ etc.}$$

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Fold

9	9	10	11	12	13	14	15	16	17	18
8	8	9	10	11	12	13	14	15	16	17
7	7	8	9	10	11	12	13	14	15	16
6	6	7	8	9	10	11	12	13	14	15
5	5	6	7	8	9	10	11	12	13	14
4	4	5	6	7	8	9	10	11	12	13
3	3	4	5	6	7	8	9	10	11	12
2	2	3	4	5	6	7	8	9	10	11
1	1	2	3	4	5	6	7	8	9	10
0	0	1	2	3	4	5	6	7	8	9
+	0	1	2	3	4	5	6	7	8	9

Fold

ADDITION GRID

Fold

9	9	18	27	36	45	54	63	72	81
8	8	16	24	32	40	48	56	64	72
7	7	14	21	28	35	42	49	56	63
6	6	12	18	24	30	36	42	48	54
5	**5**	**10**	15	20	25	30	35	40	45
4	**4**	**8**	12	16	20	24	28	32	36
3	**3**	**6**	9	12	15	18	21	24	27
2	**2**	**4**	6	8	10	12	14	16	18
1	**1**	**2**	3	4	5	6	7	8	9
×	1	2	3	4	5	6	7	8	9

Fold

PRODUCT GRID

It is advisable to orient the product grid and the addition grid as shown. This will facilitate later work with coordinates.

Addition Grid

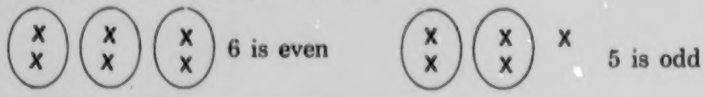
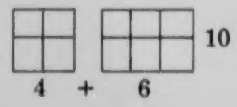
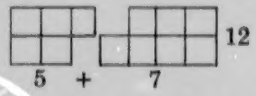
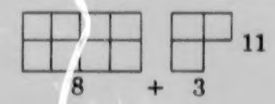
i. Note the symmetry of the table by folding it along the diagonal (as shown).
ii. Search for patterns such as identical numbers, multiples of 2, doubles, etc.
iii. Illustrate commutative property and inverse operations, etc.

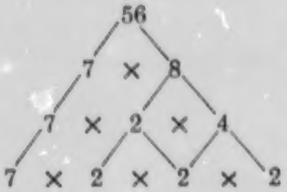
Product Grid

i. The product grid may be used as an area grid. Note the shaded section (5 × 2 = 10).
ii. Note the symmetry of the table by folding it along the diagonal (as shown).
iii. Search for patterns such as even numbers, odd numbers, square numbers, multiples, etc.
iv. Illustrate commutative property, inverse operations, factors, etc.

SUGGESTED MATERIALS

—graph paper
—transparency (grid)
—markers

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Even and Odd Numbers The student should be able to:		
1. show the difference between even and odd numbers by grouping by twos	Even and odd patterns should be located on the grids illustrated in the previous section. Arrays can be arranged into groups of 2 to identify even and odd numbers. 	—small counters —overhead projector —pipe cleaners (edges)
2. predict the sum of: — two even numbers — two odd numbers — even and odd numbers	Grid paper is an excellent device to illustrate: The sum of two even numbers.  The sum of two odd numbers.  The sum of an even and an odd number. 	—graph paper —overhead projector
C. Factors and Multiples The student should be able to:		
1. find all the factors of a given number	Introduction of factoring can be approached using the following techniques: Product grid. Sets and factor pairs: the factors of a number may be derived by dividing the number by 1, 2, 3, 4, etc., to 9. The factor pairs can then be extracted and arranged into a set, e.g., 36 = 1 × 36, 2 × 18, 3 × 12, 4 × 9, 6 × 6. Set of factors is: 1, 2, 3, 4, 6, 9, 12, 18, 36.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	The factor tree:  7 × 8 = 56 14 (7 × 2) × 4 = 56 28 (7 × 4) × 2 = 56 NOTE: Most textbooks contain good descriptions of activities with factor trees.	
2. **find common factors of two numbers**	e.g., 16→ 1, 2, 4, 8, 16 44→ 1, 2, 4, 11, 22, 44 Common factors 1, 2, 4	
3. **express multiples of a given number**	The student should be directed to the product grid (multiplication tables) for review of multiples.	
4. **find common multiples of two numbers**	e.g., 3→ 3, 6, 9, 12, ⑮ 18, 21, 24, 27, ㉚ . . . 5→ 5, 10, ⑮ 20, 25, ㉚ 35 . . . Common multiples 15, 30 . . . NOTE: IT IS IMPORTANT TO REMEMBER THAT MULTIPLES ARE INFINITE IN NUMBER, WHILE THE SET OF FACTORS OF A NUMBER IS FINITE.	
5. **find the lowest common multiple of two numbers**	From the example, 15 would be the least common multiple of 3 and 5. This is readiness for adding and subtracting fractions with unlike denominators.	
6. **discover special patterns as they relate to square numbers**	Square numbers may be illustrated with grid paper, with arrays, etc. e.g., X XX/XX XXX/XXX/XXX XXXX/XXXX/XXXX/XXXX 1 4 9 16 (1 × 1) (2 × 2) (3 × 3) (4 × 4) They are also revealed in a pattern on the product grid.	—small counters

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

D. Primes and Composites

The student should be able to:

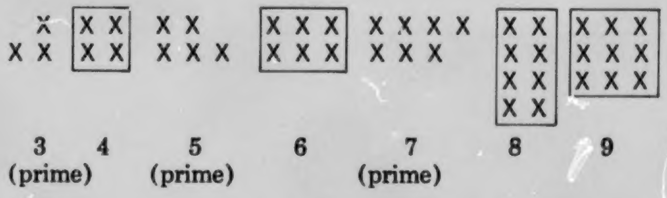
1. **list all prime numbers between 1 and 100**
2. **list all composite numbers between 1 and 100**

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

The following techniques may be used to find primes and composites:

— Cuisenaire rods
— Arrays

(When using arrays to find primes and composites each array must consist of two or more columns or rows — an exception must be made for the number two, however.)


3
(prime)
4
5
(prime)
6
7
(prime)
8
9

Prime Number—cannot be enclosed by a square or rectangle.

Composite Number—can be enclosed by a square or rectangle.

ERATOSTHENES' SIEVE

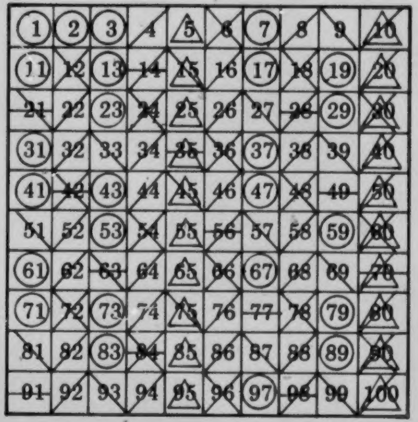
A hundred grid (as illustrated) will reveal some interesting patterns when the initial activity has been completed.

i. Draw a diagonal (/) through all the multiples of 2. Note the pattern.

ii. Draw a diagonal (\) through all the multiples of 3. Note the pattern.

iii. Draw a triangle(△) around all the multiples of 5. Note the pattern.

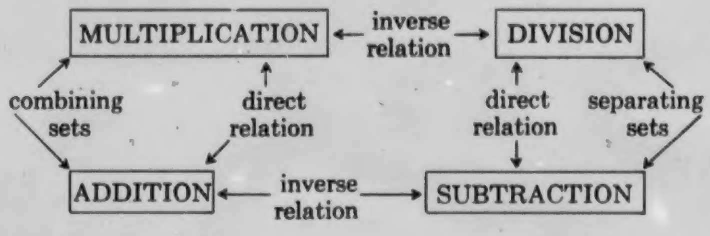
iv. Draw a line (—) through multiples of 7. Note the pattern.


1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100

SUGGESTED MATERIALS

—Cuisenaire rods or Dienes multi-base blocks
—small counters

—graph paper
—coloured pencils
—overhead projector
—transparencies
—overlays

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	The remaining numbers are prime. Is there a pattern? ○	
	Large graph paper should be used in the classroom along with coloured pencils to allow easier recognition of patterns.	
	The Factor Tree (see C 1).	
E. Rules of Divisibility		
The student should be able to:		
— tell if any number (up to 6 digits) is divisible by:	Following discovery, the rules should be maintained through application rather than straight memorization.	
	Divisibility Rules	
— 2	2—An integer has 2 as a factor if, and only if, the last digit is 0, 2, 4, 6, or 8, e.g., 1024	
— 5	5—An integer is divisible by 5 if, and only if, the last digit is 0 or 5, e.g., 15, 480, 505	
— 10	10—An integer is divisible by 10 if, and only if, the last digit is 0, e.g., 6130	
V. OPERATIONS	The diagram below shows how the four fundamental operations are related and how some field properties apply.	
Introductory Note	 MULTIPLICATION inverse relation DIVISION combining sets direct relation direct relation separating sets ADDITION inverse relation SUBTRACTION	

CONCEPTS, SKILLS AND OBJECTIVES

1. **Commutative Property — (Order)**
2. **Associative Property — (Grouping)**
3. **Property of Zero and One**
4. **Distributive Property**

Addition and Subtraction

A. Addition

1. Meaning

The student should be able to:

— exemplify concretely or pictorially the meaning of addition

2. Basic Facts

The student should be able to:

— recall with proficiency all basic addition facts

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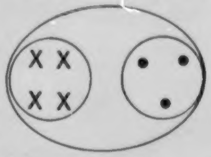
TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Addition	Multiplication
1. $2 + 3 = 3 + 2$	1. $2 \times 3 = 3 \times 2$
2. $(2 + 3) + 4 = 2 + (3 + 4)$	2. $(2 \times 3) \times 4 = 2 \times (3 \times 4)$
3. $2 + 0 = 2$	3. $2 \times 0 = 0$ $2 \times 1 = 2$
4. $2 \times (3 + 4)$ =	$(2 \times 3) + (2 \times 4)$

The meaning of addition can best be reviewed by having students join sets to form a new set.



Addition is represented by the union of two or more disjoint sets.

4 + 3 = 7

Drill Games and *Puzzles*

Cross-Out

Each pupil puts the numerals 1-9 on a piece of paper. The teacher may wish to ask that two sets of numerals be used as illustrated below:

1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9

One pupil rolls two dice and calls the sum. If the pupil has an uncovered numeral that corresponds to the number called, he or she may "cross" it out. A combination (addition) of two uncovered numerals to correspond may

SUGGESTED MATERIALS

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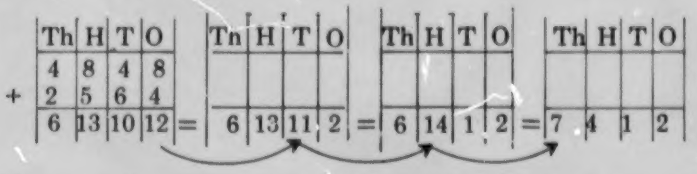
Concepts and Skills are indicated in Bold Face.

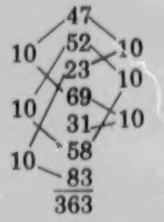
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	be used as well. In this case both numerals may be crossed out. The game continues until the student cannot match a corresponding numeral or numeral pair. The sum of the uncovered numerals is then found. The rest of the class continues to play until no-one is able to match numerals. The student must NOT change his or her selection once it has been crossed out. Lowest score wins. e.g., Numbers called (tally) 11, 9, 4, 7, 7, 3, 10, 6, 3, 3, 8, 5, 3. Student sheet $\cancel{1}\ \cancel{2}\ \cancel{3}\ \cancel{4}\ \cancel{5}\ \cancel{6}\ \cancel{7}\ \cancel{8}\ \cancel{9} = 0$ $1\ \cancel{2}\ \cancel{3}\ \cancel{4}\ \cancel{5}\ \cancel{6}\ 7\ \cancel{8}\ 9 = \underline{17}$ sum score 17	
3. Addition of 10 and its Multiples to a Number **The student should be able to:** **— add 10 and/or multiples of 10 to a given number**	Much oral work involving adding 10 or its multiples to a given number develops proficiency in work with other addends. e.g., $\begin{array}{r} 15 \\ +30 \\ \hline 45 \end{array} \longrightarrow \begin{array}{r} 10 + 5 \\ +\ 30 \\ \hline 40 + 5 \\ \hline 45 \end{array}$	
4. Mathematic Properties **The student should be able to:** **a. apply the commutative property to addition**	a. commutative: $2 + 3 = 3 + 2$ (order)	
b. apply the associative property to addition	b. associative: $(4 + 3) + 5 = 4 + (3 + 5)$ (grouping)	
c. apply the property of zero	c. zero: $0 + 7 = 7$ (0 is the identity number) or $7 + 0 = 7$ These terms need not be stressed.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. Addition with Regrouping **The student should be able to:**		
a. regroup using expanded notation	a. *expanded notation* e.g., 847 = 800 + 40 + 7 +564 = 500 + 60 + 4 = 1300 + 100 + 11 = 1300 + 110 + 1 = 1400 + 10 + 1 = 1000 + 400 + 10 + 1 = 1411	—place value chart —abacus strips —Dienes blocks
b. regroup using the place value grid	b. *place value grid* e.g.,  Th H T O + 4 8 4 8 2 5 6 4 6 13 10 12 = Th H T O 6 13 11 2 = Th H T O 6 14 1 2 = Th H T O 7 4 1 2 The preceding examples explain the algorithm by means of expanded notation and grid, but children should be allowed to use the standard algorithm as soon as they are ready to do so.	
6. Column and Horizontal Format **The student should be able to:**		
a. rewrite a horizontal addition sentence as a column addition algorithm **b. add up to four 5-digit numbers or five 4-digit numbers**	Children should be able to rewrite horizontal addition in vertical form. e.g., 723 + 73 + 1328 becomes 723 73 1328	
7. Addition of Money **The student should be able to:** **— add sums of money to the limits as in 6b above**	Children use fliers from grocery stores to make up a shopping list and find the total cost. Children use catalogues to find items for Christmas gifts and then find the total cost. Apply estimating as in #8.	—fliers —catalogues

3:8

3·9

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.	
8. Rounding Off **The student should be able to:** — round off numbers to 10's, 100's, 1000's, and 10,000's to estimate the sum	Children add rounded-off numbers to arrive at an estimated answer. This ensures a reasonably exact answer.	
9. Checking Addition **The student should be able to check addition by:**		
a. using the commutative or associative properties in horizontal or column addition	a. 13 19 403 89 972 ↓ Add Down 1496 13 ↑ 19 403 89 972 Add Up 1496 48 963 105 487 ↓ Add Down 154 450 48 963 ↑ 105 487 Add Up 154 450	
b. finding sums of ten	b.  47 52 23 69 31 58 83 363 10 10 10 10 10 10	
c. finding multiples	c. 81 87 84 86 82 420	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
10. Word Problems **The student should be able to:** **– use number sentences to solve one- and two-step word problems**	a. This example would be considered a *one-step* problem: Bob bought some gym clothing for school. The sweater cost \$5.49, the shoes \$8.99 and the shorts \$6.50. How much money did he spend? $\$5.49 + \$8.99 + \$6.50 = n$ b. This example involves a two-step problem, i.e., one involving two different operations. Jill had four pet cages. Into each cage she placed 2 guinea pigs and 3 rabbits. How many pets are in all the cages? Here is a possible method of solving the problem. Let n represent how many pets are in all the cages. $n = (2 + 3) \times 4$ $n = 5 \times 4$ $n = 20$ There are 20 pets in all the cages. EXTENSION: Use number sentences to solve three-step word problems. Generally three-step problems would involve working with 3 different operations. e.g., $(3 + 2) \times (10 - 5) = n$	
B. Subtraction **1. Meaning** **The student should be able to:** **– illustrate concretely and pictorially the meaning of subtraction**	The meaning of subtraction can be shown using the following techniques:	—counters —Dienes blocks —overhead projector —transparency —grid

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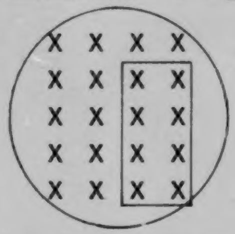
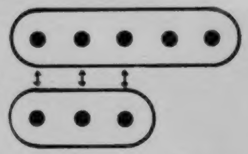
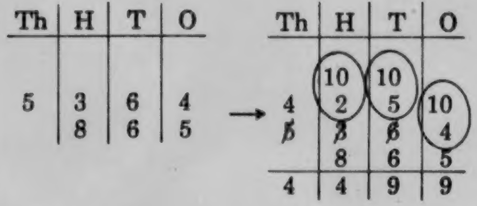
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	a. Removal of a subset Joe has 20¢. He spends 8¢ on candy. How much money has he left? 20 — 8 = ☐  20 — 8 = 12	
	b. Comparison  5 — 3 = 2 The unmatched subset of 2 in the top set illustrates the difference.	
	c. Missing addend Finding the missing addend is another method of subtraction, e.g., John has 12 cents and wants to buy a box of raisins for 20 cents. How much money does he need: 12 + ☐ = 20.	—counters —container
	d. Inverse of addition e.g., 24 — 15 = 9 because 9 + 15 = 24	
2. Subtraction with Multiples of 10 The student should be able to:		
— subtract 10 and/or a multiple of 10 from a given number	Much oral work involving the subtraction of ten or its multiples from a given number develops proficiency in later written work (algorithm).	
3. Subtraction with Regrouping The student should be able to:		
a. regroup using expanded notation	Expanded notation (not all steps are shown).	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	$\begin{array}{rcrcrcrcrcrcrcr} 5364 & = & 5000 & + & 300 & + & 60 & + & 4 & = & 4000 & + & 1200 & + & 150 & + & 14 \\ -\ 865 & = & & & 800 & + & 60 & + & 5 & = & & & 800 & + & 60 & + & 5 \\ \cline{11-17} & & & & & & & & & & 4000 & + & 400 & + & 90 & + & 9 \\ & & & & & & & & & & & & & = & 4499 \end{array}$	
b. regroup using the place value grid	Place Value Grid 	—abacus —place value charts —Dienes blocks
c. regroup with zero	$\begin{array}{r} {\scriptstyle 3991} \\ 4001 \\ -2364 \\ \hline 1637 \end{array}$	
4. Subtraction of Whole Numbers The student should be able to: — subtract numbers with up to 6 digits	e.g., $\begin{array}{r} 59\ 402 \\ -\ 39\ 783 \\ \hline 19\ 619 \end{array}$	
5. Subtraction with Money The student should be able to: a. make change readily for specific amounts of money	Oral work should be encouraged where children make change.	—real money —play money
b. apply the algorithm to solve problems involving money to the limits of #4 above	NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. Rounding Off **The student should be able to:** **— round off numbers to 10's, or multiples of 10 to estimate the difference**	The estimated answer is a means of checking whether the exact answer is reasonable. e.g., $\begin{array}{r}5283\\-3847\\\hline 1436\end{array}$ $\quad$ $\begin{array}{r}5000\\-4000\\\hline 1000\end{array}$	— number line
7. Checking Subtraction **The student should be able to:** **— use the inverse property to check answer in subtraction**	73 193 — 4286 = 68 907 because 68 907 + 4286 = 73 193	
8. Word Problems **The student should be able to:** **— use number sentences to solve one- and two-step word problems**	The following is a two-step word problem: Peter bought 3 loaves of bread each costing 28 cents. If he gave the cashier \$1.00, how much change did he receive? Possible procedures for the solution: Let n represent how much change Peter received. n = \$1.00 — (3 × 28) n = \$1.00 — 84 n = 16 Peter received 16¢ change. EXTENSION: Use number sentences to solve three-step word problems. Three-step word problems generally involve using three different operations. Sadie bought 3 packages of popsicle sticks at \$3.59 each and 2 tubes of glue, each costing \$1.19 at the hobby shop. How much change did she receive from \$20.00? n = \$20.00 — (3 × \$3.59) + (2 × \$1.19) NOTE: Operations in brackets must be done first.	

CONCEPTS, SKILLS AND OBJECTIVES

Multiplication and Division

C. Multiplication

1. Meaning

The student should be able to:

— illustrate concretely and pictorially the meaning of multiplication

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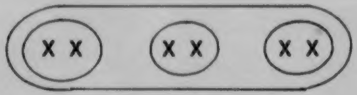
TEACHER'S NOTES AND SUGGESTED ACTIVITIES

The teacher might find it necessary to review the meaning of multiplication by using simple models.

a. Addition of equivalent sets.

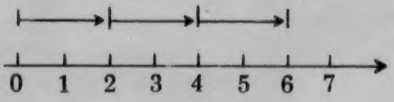


2 + 2 + 2 = 6
OR
3 twos = 6
OR
3 × 2 = 6

b. Arrays

✱✱ 3 twos = 6
✱✱ OR
✱✱ 3 × 2 = 6

c. Number line



3 twos = 6
OR
3 × 2 = 6

SUGGESTED MATERIALS

The following materials are useful [illegible] skills 1 to 4:

—numbered cubes
—number line
—hundred chart
—individual hundred chart (dittoed)
—arrays
—flashcards
—counters
—Dienes blocks
—geoboards
—balance beam
—Cuisenaire rods
—egg cartons
—games: "Tuf", "Heads Up", "The Winning Touch", "Krypto", "Top This"

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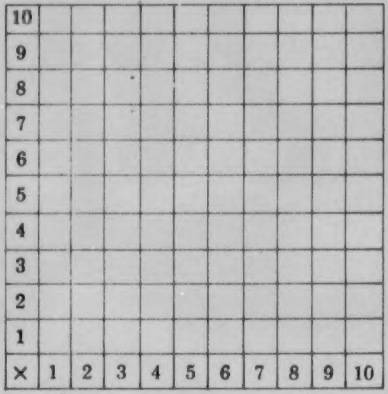
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Basic Facts **The student should be able to:** **— recall with proficiency the basic multiplication facts up to 100**	Use games and activities to reinforce the facts and to provide the necessary drill.	
3. Multiplying by 10's, 100's, 1000's and Their Multiples **The student should be able to:** **— multiply a number by 10's, 100's and 1000's, and their multiples, both oral and written**	Multiplying by 10's, 100's and 1000's should be emphasized as this will be a real asset when working with the metric system (decimal).	
4. Mathematical Properties **The student should be able to:** **a. apply the commutative property to multiplication**	The following mathematical properties of multiplication should be reviewed. commutative: order $3 \times 5 = 5 \times 3$	—counters —Product Grid  10 9 8 7 6 5 4 3 2 1 × 1 2 3 4 5 6 7 8 9 10
b. apply the associative property to multiplication	associative: grouping $(4 \times 6) \times 2 = 4 \times (6 \times 2)$	
c. apply the distributive property to multiplication	distributive: applied in the algorithm $47 \times 25 = (40 \times 25) + (7 \times 25)$ $\begin{array}{rl} 25 & \\ \times\,\underline{47} & \\ 175 = & 7 \times 25 \\ \underline{1000} = & \underline{40 \times 25} \\ 1175 & 47 \times 25 \end{array}$	
d. apply the property of zero in multiplication	$93 \times 0 = 0$ OR $0 \times 93 = 0$	

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Concepts and Skills are indicated in Bold Face.

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
apply the property of one in [illegible]plication	identity number: $82 \times 1 = 82$ OR $1 \times 82 = 82$	
5. Multiplication with Regrouping **The student should be able to:**		
a. regroup using expanded notation	expanded notation: *Step 1* $\begin{array}{rl} 24 & = 2 \text{ tens} + 4 \text{ ones} \\ \underline{\times\ 3} & \quad\quad \times 3 \\ \hline & 6 \text{ tens} + 12 \text{ ones} \\ & \quad = 60 + 12 \\ & \quad = 72 \end{array}$ *Step 2* $\begin{array}{rcl} 24 & = & 20 + 4 \\ \underline{\times\ 3} & & \underline{\quad \times 3} \\ & & 60 + 12 \\ & & = 72 \end{array}$	
b. regroup using the place value grid	place value grid: *Step 3* $\begin{array}{r\|l} T & O \\ \hline 2 & 4 \\ \times & 3 \\ \hline 1 & 2 = 3 \times 4 \\ 6 & 0 = 3 \times 20 \\ \hline 7 & 2 = 3 \times 24 \end{array}$ algorithm: *Step 4* $\begin{array}{r} 24 \\ \times\ 3 \\ \hline 72 \end{array}$ The examples explain the algorithm by means of expanded notation and grid. However, students should be encouraged to use the standard algorithm.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. Multiplication Algorithm **The student should be able to:** **— demonstrate the use of the standard algorithm by multiplying up to 4 digits by 3 digits**	To develop proficiency in using the algorithm the students should have mastered the basic facts in addition and multiplication, and the concepts of place value and distributive property: Place value $\begin{array}{rl} 463 & \\ \times\ \underline{7} & \\ 21 & \text{(ones)} \\ 42 & \text{(tens)} \\ \underline{28} & \text{(hundreds)} \\ 3241 & \end{array} \qquad \begin{array}{r} 463 \\ \times\ \underline{7} \\ 21 \\ 420 \\ \underline{2800} \\ 3241 \end{array}$ Distributive property (the box shows the desired algorithm) $\boxed{\begin{array}{r} 463 \\ \underline{\times\ \ 27} \\ 3\ 241 \\ \underline{9\ 260} \\ 12\ 501 \end{array}} \qquad \begin{array}{r} 7 \times 463 \\ \underline{20 \times 463} \\ 27 \times 463 \end{array}$	
7. Multiplication with Money **The student should be able to:** **a. multiply given amounts of money using semi-concrete aids** **b. apply the algorithm to solve problems with money** **c. solve "money problems" to the limits expressed in #6**	The teaching of money problems could develop in the following ways: a. Select problems meaningful to children in their everyday life, e.g., 2 cans of juice cost 69¢. What is the cost of 10 cans? b. Games — such as "Masterpiece", "Stockticker". c. Class projects — paying for a class party or activity, finding the total cost of birthday or Christmas gifts received by students in the class. NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
8. Rounding Off The student should be able to:		
a. round off numbers to 10's or its multiples to estimate the product	*Exact* 24 763 × 319 222 867 247 63 7 428 9 7 899 397 *Estimation* Encourage an estimated answer first. 25 000 × 300 7 500 000 The rounding off could, of course, be done to any place value. However, the purpose is to arrive at the estimated answer orally. The exact answer should be calculated after the estimated answer has been obtained.	—number line
b. compare the exact answer to the estimated answer	Again, encourage mental calculation for the estimated product.	
9. Checking Multiplication The student should be able to:		
— apply the commutative property as a means of checking multiplication	359 × 421 359 7 180 143 600 151 139 421 × 359 3 789 21 050 126 300 151 139	
10. Word Problems The student should be able to:		
— use number sentences to solve one- and two-step word problems	See section in grade 4 on word problems. EXTENSION: Use number sentences to solve three-step word problems.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Division **1. Meaning** **The student should be able to:**		
a. illustrate concretely or pictorially the meaning of a division number sentence	The meaning of division can be reviewed by having the students find the number of equivalent subsets in a given set and may be expressed as: i. repeated subtraction $32 \div 8 = 4$ $\begin{array}{r} 32 \\ -\underline{8} \\ 24 \\ -\underline{8} \\ 16 \\ -\underline{8} \\ 8 \\ -\underline{8} \\ 0 \end{array}$ Since 8 was subtracted four times, there are four 8's in 32. ii. inverse of multiplication $32 \div 8 = \square, 4 \times 8 = 32$ iii. missing factor $\square \times 8 = 32$	—counters —number line —hundred chart —games, e.g., "The Winning Touch"
b. recognize, interpret and apply different division formats	Division Formats i. $8 \div 4 = 2$ ii. $4\overline{)8}$ with 2 above iii. $\frac{8}{4} = 2$ iv. $\frac{1}{4}$ of $8 = 2$	
c. understand the meaning of divisor, dividend, quotient, remainder, missing factor, divisible	The language of division (divisor, dividend, quotient, divisible, divisibility, factors, etc.) may be used by the teacher, but students need not be required to use these terms. NOTE: New texts advocate the use of product factor and missing factor instead of the above terminology.	
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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Dividing with 10 and Multiples of 10 The student should be able to: – divide where both divisor and dividend are multiples of 10	$\begin{array}{r}3\,200\\300\overline{)960\,000}\end{array}$	
3. Mathematical Properties The student should be able to:		
a. apply the property of zero to division	0 ÷ 4 = 0 The fact that division by zero (i.e., 9 ÷ 0) is undefined might be left for study in a later grade.	
b. apply the property of one to division	8 ÷ 1 = 8 $1 \div 8 = \frac{1}{8}$	
c. apply the distributive property in mental arithmetic	This property is useful to facilitate mental calculations. $4\overline{)508}$ (400 ÷ 4) + (100 ÷ 4) + (8 ÷ 4) 100 + 25 + 2 127 There are other ways of distributing 508.	
4. The Division Algorithm The student should be able to:		
a. demonstrate the use of the standard algorithm by using up to a 6-digit dividend and a 2-digit divisor i. without remainders	There are many different forms of recording division work, but the aim should be to use the standard algorithm as the desired form. Note the different forms for dividing: 624 ÷ 52. a. *Repeated Subtraction Form* $\begin{array}{rl}624 & \\ -\underline{52} & \text{— once}\\ 572 & \\ -\underline{52} & \text{— twice}\\ 520 & \\ -\underline{52} & \\ 468 & \end{array} \quad \begin{array}{rl} \vdots & \\ 52 & \\ -\underline{52} & \\ 0 & \text{— twelve times}\end{array}$ Since 52 can be subtracted 12 times, there are 12 52's in 624.	
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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. *Scaffold Form* 52/624 520 10 104 104 2 0 12 c. *Pyramid Form* 12 2 10 52/624 520 104 104 0 d. *Standard Algorithm Form* 12 52/624 520 104 104 0 Remainders may be expressed as whole numbers or as fractions where applicable. A good way of recording the remainder is by placing it above a fraction line.	
ii. with remainders	$143\frac{50}{}$ 52/7486 52 228 208 206 156 50 i.e., $5\frac{2}{}$ 3/17 This format facilitates the recording of a remainder as a fraction, i.e., $5\frac{2}{3}$ 3/17	
b. use the "short division" algorithm where applicable	As students gain competence with estimation, division, and multiplication facts they should be directed to use the "short division" algorithm where it applies. e.g., $987\frac{1}{6}$ 6/5923	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. Division of Money **The student should be able to:** **— divide an amount of money where the digits do not exceed the limits stated in #4**	NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education. If a remainder exists, students should be directed to: (1) leave the remainder, (2) round off the answer to the nearest cent, or (3) write it as a fraction, as is appropriate for the problem.	
6. Rounding Off **The student should be able to:** **— round off numbers to 10 or multiples of 10 to estimate the quotient**	Oral estimating should be encouraged, and then the exact answer should be compared with the estimated answer.	
7. Checking Division **The student should be able to:** **— use the inverse operation to check answers in division, and add the remainder where applicable**	$\begin{array}{r} 234\ \underline{25} \\ 42\overline{)9853} \\ \underline{84} \\ 145 \\ \underline{126} \\ 193 \\ \underline{168} \\ 25 \end{array}$ Check: $\begin{array}{r} 234 \\ \times\ \underline{42} \\ 468 \\ \underline{936} \\ 9828 \\ +\ \underline{25} \\ 9853 \end{array}$ Add remainder	
8. Average or Arithmetic Mean **The student should be able to:** **— compute the average of two or more numbers**	Special problems related to sports, to distances in travelling, etc., develop the concept of average. e.g., The Browns were on a trip and travelled these distances in 5 days: 352 km, 465 km, 318 km, 392 km, 509 km. What was the average distance they travelled each day? n = (352 + 465 + 318 + 392 + 509) ÷ 5 NOTE: Correlate with graphing.	

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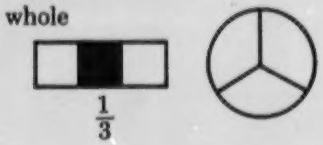
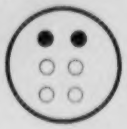
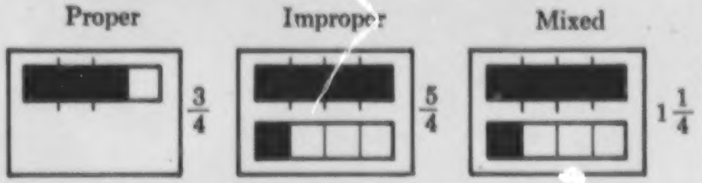
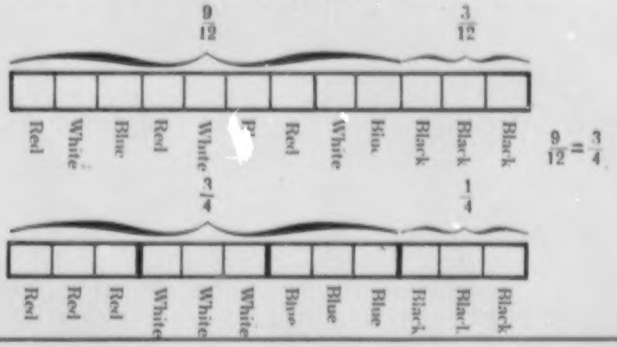
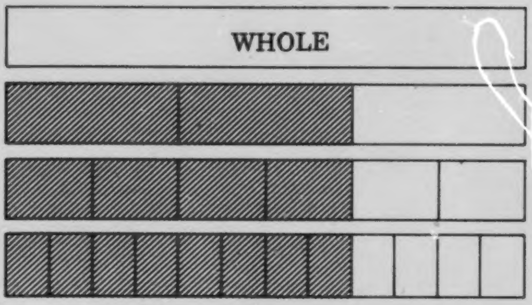
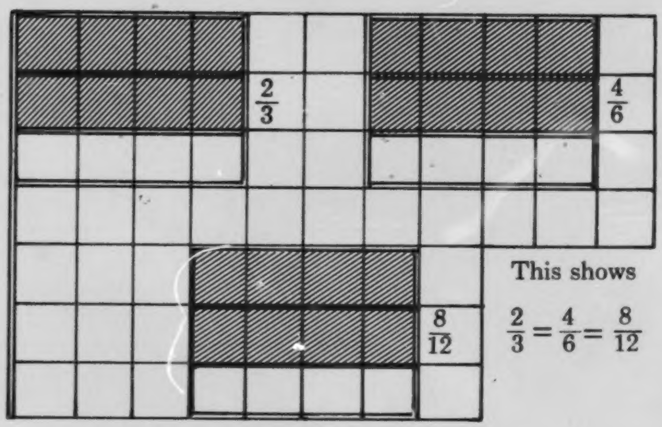
Concepts and Skills are indicated in Bold Face.

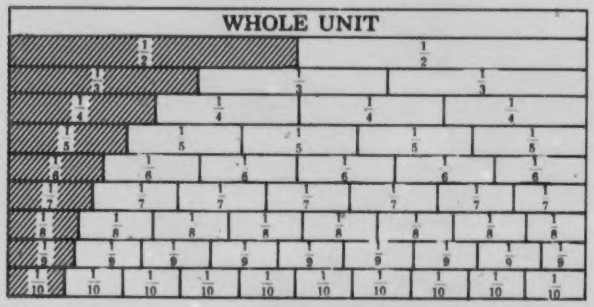
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
9. Word Problems **The student should be able to:** **— use number sentences to solve one- and two-step problems**	See section in grade 4 on word problems and problem solving.	
VI. FRACTIONS **A. Meaning** **The student should be able to:** **1. illustrate concretely or pictorially the meaning of a fraction**	Children should be able to interpret the meaning of a fraction by identifying the fraction using concrete or pictorial materials. These should include a variety of models and shapes, i.e., circles, rectangles, triangles, etc. The meaning of fractions should be illustrated as: i. part of a whole (unit)  ii. part of a group or set  $\frac{1}{3}$ of 6 = 2 iii. a ratio ● ○ ○ 2 out of 6 ● ○ ○ 2:6 as 1:3	—pie plates —fraction bars —grid paper —counters (various colours)
2. understand the meaning of numerator, denominator, proper fraction, improper fraction, mixed number, equivalent fraction	The terminology should be used as much as possible in context rather than simply memorized. Continued meaningful use will lead to better understanding. Illustrate the three types of fractions as they are related to the same unit.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	 Proper Improper Mixed 3/4 5/4 1 1/4 NOTE: It is strongly recommended that we use the horizontal fraction line — $\frac{2}{3}$ — rather than the diagonal line (2/3), as this will facilitate recognition, operations and later algebraic concepts.	
B. Equivalent Fractions **The student should be able to:** **1. illustrate equivalence of fractions using concrete and semi-concrete models**	Activities should be planned involving concrete and semi-concrete aids, where children find the equivalent fractions by using the aids. a. Pencil lines can be used to divide plasticine models (pressed into jar lids or boxes) into parts. (The lines can subsequently be erased by rubbing with the finger.) b. Unifix blocks can be assembled to show equivalence.  9/12 3/12 Red White Blue Red White Blue Red White Blue Black Black Black 9/12 = 3/4 3/4 1/4 Red Red Red White White White Blue Blue Blue Black Black Black	—overhead transparencies —cardboard plates —geometric shapes —cubes —egg cartons —plasticine pressed in lids of jars or boxes —paper fraction strips —fraction board —fraction dominoes —"Concentration" (matching game) —geoboard —Unifix blocks —square grid paper

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
432	c. Fraction bars, Vistrum compacts, and Cuisenaire rods can be used similarly.  This shows $\frac{2}{3}=\frac{4}{6}=\frac{8}{12}$ d. Strips of paper of equal length can be given to a group of children. Each strip is folded into equal parts: halves, fourths, etc. The folds are well marked with a crayon. All strips are then pinned or taped, one under the other, and equivalent parts are found and named as fractions. e. Area regions on square grid paper can be used as illustrated below.  This shows $\frac{2}{3}=\frac{4}{6}=\frac{8}{12}$ This illustration could be transferred to a geoboard.	—fraction transparencies —overlays 433

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

f. The fraction chart can be made to show that certain sets of fractions are equivalent whereas others are not equivalent.



FRACTION CHART

e.g., $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10}$

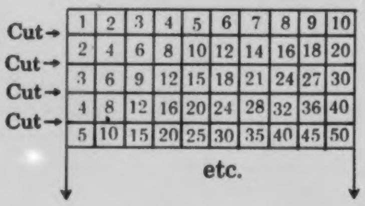
but, $\frac{1}{2} \neq \frac{\ }{3} \neq \frac{\ }{5} \neq \frac{\ }{7} \neq \frac{\ }{9}$

Students could be asked to construct a wall-sized fraction chart.

2. illustrate equivalent sets of fractions symbolically

a. Multiple rods can be constructed to make sets of equivalent fractions, by cutting up a multiplication grid. Any two rods placed one below the other will form a set of equivalent fractions, e.g., the "multiples of 2" rod and the "multiples of 3" rod, when placed below each other will form this set:

$\frac{2}{3}, \frac{4}{6}, \frac{6}{9}, \frac{8}{12}, \frac{10}{15}, \frac{12}{18}, \frac{14}{21}, \frac{16}{24}, \frac{18}{27}, \frac{20}{30}$



1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50

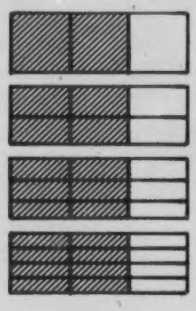
Multiplication Grid

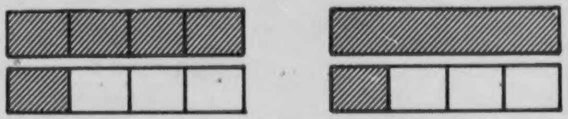
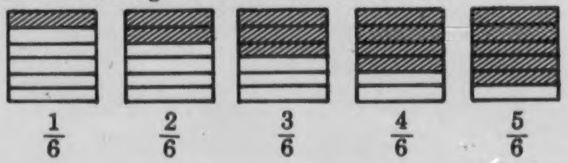
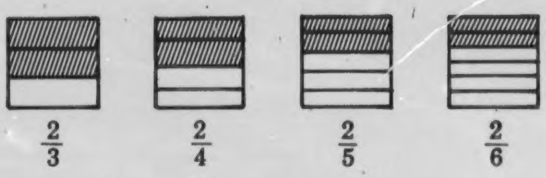
e.g., Equivalent set for $\frac{2}{3}$

2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30

e.g., Equivalent set for $\frac{2}{5}$

2	4	6	8	10	12	14	16	18	20
5	10	15	20	25	30	35	40	45	50

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	b. Forming sets of equivalent fractions: In $\frac{2}{3}, \frac{4}{6}, \frac{6}{9}, \frac{8}{12}, \frac{10}{15} \ldots$ the children should be able to tell how they arrived at each consecutive equivalent fraction:  $\frac{2}{3}$ $\frac{2}{3} \times \frac{2}{2} = \frac{2 \times 2}{3 \times 2} = \frac{4}{6}$ $\frac{2}{3} \times \frac{3}{3} = \frac{2 \times 3}{3 \times 3} = \frac{6}{9}$ $\frac{2}{3} \times \frac{4}{4} = \frac{2 \times 4}{3 \times 4} = \frac{8}{12}$ etc.	
3. reduce a fraction to its lowest term	Much exposure to the type of work suggested above for equivalent fractions should help the child understand the concept of reducing fractions. After considerable work with aids, the student should be able to reduce using division by a form of one. Students should learn to look for common factors of the numerator and denominator. e.g., $\frac{16}{24} \div \frac{2}{2} = \frac{8}{12} \div \frac{2}{2} = \frac{4}{6} \div \frac{2}{2} = \frac{2}{3}$ OR $\frac{16}{24} \div \frac{4}{4} = \frac{4}{6} \div \frac{2}{2} = \frac{2}{3}$ OR $\frac{16}{24} \div \frac{8}{8} = \frac{2}{3}$ Any of the above forms are acceptable at this level. Common factors can be listed as sets of factors. e.g., $\frac{18}{27}$ The factors are: $18(1, 18, 2, \underline{9}, \underline{3}, 6)$ or $18(1, 2, 3, 6, 9, 18)$ $27(1, 27, \underline{3}, \underline{9})$ or $27(1, 3, 9, 27)$	—egg cartons —circles, rectangles —number line

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Thus common factors are 3 and 9. Therefore, $\frac{18}{27} \div \frac{3}{3} = \frac{6}{9} \div \frac{3}{3} = \frac{2}{3}$ or better, $\frac{18}{27} \div \frac{9}{9} = \frac{18 \div 9}{27 \div 9} = \frac{2}{3}$ However, *use of the Greatest Common Factor (9) is left to grade 6.*	
4. rename an improper fraction as a mixed number or whole number and vice versa	 $\frac{5}{4} = 1\frac{1}{4}$	
C. Comparing Fractions **The student should be able to:**		
1. compare fractions where the denominator remains the same and the numerator changes	The student can again use models as follows:  $\frac{1}{6}$ $\frac{2}{6}$ $\frac{3}{6}$ $\frac{4}{6}$ $\frac{5}{6}$	—fraction transparency —overlays
2. compare fractions where the numerator remains the same and the denominator changes	 $\frac{2}{3}$ $\frac{2}{4}$ $\frac{2}{5}$ $\frac{2}{6}$	
3. compare fractions with unlike numerators and denominators where the lowest common denominator (L.C.D.):		
a. is one of the given denominators	e.g., $\frac{7}{10}, \frac{4}{5}$ L.C.D. is 10	
b. is the product of two of the denominators	e.g., $\frac{2}{3}, \frac{3}{4}$ L.C.D. is 3 × 4 or 12 OR $\frac{1}{4}, \frac{2}{3}, \frac{3}{4}$ L.C.D. is 3 × 4 or 12	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

c. is a multiple less than the product of two of the denominators

e.g., $\frac{5}{6}, \frac{7}{9}$ L.C.D. is 18, which is less than 6 × 9 or 54

A number of methods can be used to find the lowest common denominator (L.C.D.) for comparing fractions:

Multiple rods could again be used.

e.g., to compare $\frac{2}{3}$ and $\frac{3}{4}$, select the "2 rod" and the "3 rod" to form the set of equivalent fractions for $\frac{2}{3}$, thus:

2	4	6	8	10	12	14	16	18	20
3	6	9	⑫	15	18	21	24	27	30

Similarly, find the 3 rod and 4 rod to form the set of equivalent fractions for $\frac{3}{4}$:

3	6	9	12	15	18	21	24	27	30
4	8	⑫	16	20	24	28	32	36	40

We see that the L.C.D. is 12 and that $\frac{2}{3} = \frac{8}{12}$ and $\frac{3}{4} = \frac{9}{12}$. Thus, $\frac{2}{3}$ is less than $\frac{9}{12}$.

Another method would be to find multiples of the largest denominator and note which is also a multiple of the other denominators.

e.g., compare $\frac{5}{6}, \frac{7}{9}, \frac{11}{12}$

Multiples of 12 (the largest denominator) are 12, 24, 36 . . . 36 is also a multiple of 9 (4 × 9 = 36) and a multiple of 6 (6 × 6 = 36). Thus, the L.C.D. is 36.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Now the "multiplying by a form of one" step is very useful: $\frac{11}{12} \times ? = \frac{}{36}$; so $\frac{11}{12} \times \frac{3}{3} = \frac{33}{36}$ $\frac{5}{6} \times ? = \frac{}{36}$; so $\frac{5}{6} \times \frac{6}{6} = \frac{30}{36}$ $\frac{7}{9} \times ? = \frac{}{36}$; so $\frac{7}{9} \times \frac{4}{4} = \frac{28}{36}$ Therefore, the fractions can be compared: $\frac{7}{9} < \frac{5}{6} < \frac{11}{12}$	
4. compare fractions by arranging them in order from smallest to largest or vice versa	The above-mentioned procedures will help in ordering fractions.	
D. Fractions as Division **The student should be able to:**		
1. express division of two whole numbers as a fraction	e.g., $6 \div 2 = 3 \rightarrow \frac{6}{2} = 3$ $6 \div 3 = \frac{6}{3}$	
2. write a remainder in division as a fraction (where applicable)	e.g., $5 \div 3 = 1\frac{2}{3} \rightarrow \frac{5}{3} = 1\frac{2}{3}$ NOTE: It would be applicable to write the remainder as a fraction here: three men share five meat pies. However, it would *not* be applicable to write the remainder as a fraction here: three cars carry five people. How many will there be in each car?	
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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Addition of Fractions	In addition of fractions, many of the ideas used in equivalent fractions and comparing fractions would apply.	
The student should be able to:		
1. add proper fractions with like denominators where the sum:		
a. is less than one	$\frac{1}{4}+\frac{1}{4}=\frac{1}{2}$	—Unifix cubes —Dienes blocks —grid paper
b. is equal to one	$\frac{1}{2}+\frac{1}{2}=1$	
c. is greater than one	$\frac{3}{4}+\frac{3}{4}=\frac{6}{4}$	
2. add mixed numbers and proper fractions with like denominators, but no regrouping	e.g., no regrouping $1\frac{1}{5}+\frac{3}{5}=1\frac{4}{5}$ *regrouping* $1\frac{4}{5}+\frac{3}{5}=1\frac{7}{5}=2\frac{2}{5}$ NOTE: *This will be left to a later grade.*	
3. add proper fractions with unlike denominators where the sum:		
a. is less than one	$\frac{1}{2}+\frac{1}{4}=\frac{2}{4}+\frac{1}{4}=\frac{3}{4}$	
b. is equal to one	$\frac{1}{3}+\frac{4}{6}=\frac{2}{6}+\frac{4}{6}=\frac{6}{6}=1$	
c. is greater than one	$\frac{1}{2}+\frac{3}{4}=\frac{2}{4}+\frac{3}{4}=\frac{5}{4}=1\frac{1}{4}$	
444		445

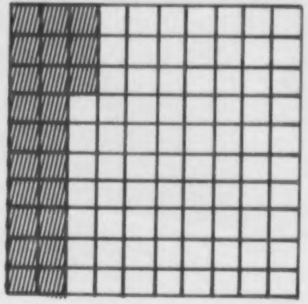
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. add mixed numbers and proper fractions with unlike denominators, but no regrouping	e.g., $3\frac{1}{4}+\frac{1}{6}=3\frac{3}{12}+\frac{2}{12}=4\frac{5}{12}$ EXTENSION: Add mixed numbers and proper fractions up to three addends with unlike denominators, but no regrouping.	
5. add using vertical and horizontal notation	$\frac{1}{2}+\frac{3}{4}=\frac{2}{4}+\frac{3}{4}=\frac{5}{4}=1\frac{1}{4}$ $\begin{array}{r}\frac{1}{2}\\ +\frac{3}{4}\\ \hline \end{array} \qquad \begin{array}{r}\frac{2}{4}\\ +\frac{3}{4}\\ \hline \frac{5}{4}\end{array}$	
6. apply the properties of whole numbers (commutative, associative, zero) to addition of fractions	Children should be able to discover that the properties of whole numbers apply in the same way to the rationals (fractions). *Use of models to illustrate the properties is highly recommended.* See section on word problems and problem solving in grade 5.	
7. use number sentences to solve one- and two-step word problems		
F. Subtraction of Fractions		
The student should be able to:		
1. subtract proper fractions with like denominators	$\frac{3}{4}-\frac{1}{4}=\frac{2}{4}$	
2. subtract proper fractions from a mixed number with like denominators (no regrouping)	$1\frac{3}{5}-\frac{2}{5}=\frac{8}{5}-\frac{2}{5}=\frac{6}{5}=1\frac{1}{5}$	
3. subtract a proper fraction or mixed number from a whole number 446	Review the renaming of 1. Visual aids such as diagrams or transparencies where 1 is represented by a fraction should be used. $5-\frac{3}{5}=\frac{25}{5}-\frac{3}{5}=\frac{22}{5}$	—fraction models —number line 447

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. subtract a mixed number from a mixed number with like denominators but no regrouping	*no regrouping* $\begin{array}{r} 2\frac{3}{4} \\ -1\frac{1}{4} \\ \hline 1\frac{2}{4}=1\frac{1}{2} \end{array}$ *regrouping* $\begin{array}{r} 3\frac{1}{4}=2\frac{5}{4} \\ -1\frac{3}{4}=1\frac{3}{4} \\ \hline 1\frac{2}{4}=1\frac{1}{2} \end{array}$ *This will be left to a later grade.*	
5. subtract a mixed number from a mixed number with unlike denominators with no regrouping	$3\frac{1}{3}-1\frac{1}{6}=3\frac{2}{6}-1\frac{1}{6}=2\frac{1}{6}$	
6. use both the horizontal and vertical forms	NOTE: *It is strongly recommended that we use the horizontal fraction line* $\left(\frac{2}{3}\right)$ *rather than the diagonal line* (2/3) as this will facilitate recognition, operations, and later algebraic concepts.	
7. use number sentences to solve one- and two-step word problems	See section on word problems and problem solving in grade 5.	
VII. DECIMALS		
A. Meaning		
The student should be able to understand decimals:		
1. as a form of representing fractional numbers in base ten (decimal system)	A variety of semi-concrete aids are helpful.	—overhead projector —transparency grid —overlays —squared paper —units and flats from Dienes blocks

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

i. square paper grid

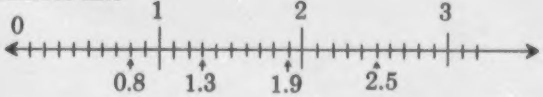


1 square = $\frac{1}{100}$ of the unit

1 column = $\frac{1}{10}$ or $\frac{10}{100}$ of the unit

$$\text{e.g., } 0.23 = \frac{2}{10} + \frac{3}{100} = \frac{20}{100} + \frac{3}{100} = \frac{23}{100} = 0.23$$

ii. number line



—number line

2. by an extension of the place value grid

place value grid

	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
		0.	2	3	

3. by relating to our money system

$3.28

$	dimes	cents
3	2	8

4. by relating to the SI metric system

e.g., SI 5.47 m

m	dm	cm
5	4	7

5 m and 4 dm and 7 cm

5 m and $\frac{4}{10}$ m and $\frac{7}{100}$ m

$$5\text{ m} + \frac{40}{100}\text{ m} + \frac{7}{100}\text{ m}$$

$$5\text{ m} + \frac{47}{100}\text{ m} = 5.47\text{ m}$$

—metre sticks with subdivisions in dm and cm

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Place Value **The student should be able to:**		
1. read and write decimal numbers up to 3 places	e.g., 42.057 may be read as i. 42 point zero five seven *or* ii. 42 decimal zero five seven *or* iii. 42 and fifty-seven thousandths	
2. give the value of any digit in a decimal number	e.g., 0.509 — 0 ones and 5 tenths and 0 hundredths and 9 thousandths	
C. Expanded Notation **The student should be able to:**		
— write decimals up to 3 places in expanded notation	e.g., 4.076 = 4 ones + 0 tenths + 7 hundredths + 6 thousandths $4.076 = 4 + \frac{0}{10} + \frac{7}{100} + \frac{6}{1000}$	
D. Renaming Decimals **The student should be able to:**		
— express decimals up to 3 places in fractional notation in reduced form and vice versa	e.g., $0.14 = \frac{14}{100} = \frac{7}{50}$ e.g., $\frac{2}{5} = \frac{4}{10} = 0.4$ The following game is suggested to help in relating fractions and decimals: use one pack of cards with fractions $\left(\frac{3}{10}, \frac{5}{100}, \frac{7}{10}, \frac{9}{100}, \text{etc.}\right)$ and one pack of cards with decimal notations (0.3, 0.03, 0.003, 0.5, etc.). Player picks a fraction and finds matching decimal notation. Rules of the game are most flexible and should be determined by the teacher.	—cards as indicated in the game
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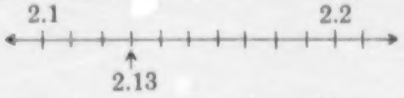
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Rounding Off		
The student should be able to:		
— round off decimals to wholes, tenths, or hundredths	Rounding off decimals should be treated in a similar way as rounding off whole numbers. e.g.,  2.13 to the nearest tenth would be rounded off to 2.1. Here only the part of the number line between 2.1 and 2.2 should be seen by the student.	—number line
F. Addition and Subtraction		
The student should be able to add or subtract decimals:		
1. using tenths, hundredths, or thousandths	$\begin{array}{r} 0.7 \\ 1.6 \\ +\ 2.3 \\ \hline 4.6 \end{array}$ $\begin{array}{r} 7.03 \\ 2.91 \\ +\ 3.27 \\ \hline 13.21 \end{array}$ $\begin{array}{r} 0.671 \\ 2.395 \\ +\ 8.742 \\ \hline 11.808 \end{array}$ $\begin{array}{r} 2.7 \\ -\ 1.4 \\ \hline 1.3 \end{array}$ $\begin{array}{r} 7.03 \\ -\ 2.91 \\ \hline 4.12 \end{array}$ $\begin{array}{r} 2.718 \\ -\ 1.674 \\ \hline 1.044 \end{array}$	
2. using a combination of tenths, hundredths and thousandths	$\begin{array}{r} 0.7 \\ 21.912 \\ +\ 7.08 \\ \hline 29.692 \end{array}$ $\begin{array}{r} 27.827 \\ -\ 16.301 \\ \hline 11.526 \end{array}$	
3. using vertical and horizontal notation	vertical — see above horizontal — $2.756 + 3.132 = 5.888$ $5.888 - 2.756 = 3.132$	
4. use number sentences to solve one- and two-step problems		
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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VIII. MEASUREMENT **Readiness for Metric Measure** 456	Problems related to metric measuring lend themselves quite easily to addition and subtraction of decimals. Problems involving money are excellent and most relevant. 1. Estimation plays an important role in the development of measurement. It should always be encouraged before making an exact measurement. 2. Initially students will measure with non-standard units and then with the appropriate metric unit. 3. Children should learn to use these terms as much as possible. They should be involved in vocabularly related to their social experiences, e.g., I weigh 40 kilograms. (In everyday life, mass and weight are often used interchangeably.) 4. *Do not convert* from the present Imperial system, use the new unit for measuring. However, there are times when it might be helpful to compare the new unit to the known unit, e.g., a litre is a little smaller than a quart. 5. Measurement should not be treated as an isolated unit of learning, but it should be a continuous learning experience throughout the year. 6. The textbook you are using may not have a full metric program and you might need supplementary material. 7. Most of the activities should be done in small groups so that each pupil may participate.	457

CONCEPTS, SKILLS AND OBJECTIVES

A. Linear Measurement

The student should be able to:

1. **recall the concepts of kilometre, metre, decimetre, and centimetre with measurement activities**
2. **estimate and measure length using the millimetre (mm)**
3. **express linear relationships using multiples and submultiples of the metre (i.e., prefixes)**
4. **relate the metric system to the decimal numeration system**

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Measuring experiences will provide a good opportunity for review of m, dm, cm, as well as km, and the introduction of mm. Integration of metric activities in physical education is excellent — running the 100 m, 200 m, etc., walking 1 km.

Construction of a metric grid following the activities will simplify the understanding of the metric system.

kilo	hecto	deca	unit	deci	centi	milli
km	hm	dam	m	dm	cm	mm
1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
5 5	0 0	0 0	0 0	 0	 0	

i.e., 5 km = 5000 m
= 500 000 cm } refer to grid above

The underlined measures are the commonly used measures in SI.

The above grid has the same structure as a base ten place value grid.

SUGGESTED MATERIALS

- —surveyor's tape (metric ropes cut in lengths of 10 m, 100 m, etc.)
- —metre stick
- —trundle wheel
- —calipers
- —micrometer

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
5. add and subtract linear measures without and with regrouping	e.g., $\begin{array}{rrr} 2\text{ m} & 38\text{ cm} & 8\text{ mm}\\ \underline{5\text{ m}} & \underline{70\text{ cm}} & \underline{5\text{ mm}}\\ 7\text{ m} & 108\text{ cm} & 13\text{ mm}\\ 8\text{ m} & 9\text{ cm} & 3\text{ mm}\end{array} \longrightarrow \begin{array}{rr} 2\text{ m} & 38.8\text{ cm}\\ \underline{5\text{ m}} & \underline{70.5\text{ cm}}\\ 7\text{ m} & 109.3\text{ cm}\\ 8\text{ m} & 9.3\text{ cm}\end{array} \longrightarrow$ $\longrightarrow \begin{array}{r} 2.388\text{ m}\\ \underline{5.705\text{ m}}\\ 8.093\text{ m}\end{array}$	
6. select the appropriate unit for estimating and measuring length	Students should learn to select the appropriate unit for measuring length. For instance, it would be rather tedious to measure the length of the school building in mm or cm, or the distance from Winnipeg to Falcon Lake in metres.	
7. estimate and measure the perimeter of objects and shapes in the appropriate unit (m, cm, mm)	The perimeter of regular and irregular shapes could be found using transparent cm² grids and recorded in metric measure (m, cm, etc.). Children could find shortcuts in finding perimeter of regular quadrilaterals which should lead to establishing a formula, i.e., $p = 2L + 2W$.	—geoboards —graph paper —cut-out shapes
B. Area		
The student should be able to:		
1. recall the concept of cm^2 and m^2 by construction and measurement activities	It is essential that children understand that area, which is two-dimensional, be measured with a unit which has the same attribute of being two-dimensional. Activities involving finding the area of a region, using cm², lead to a better understanding of further work in area with larger units. This can also be exemplified with the use of a plane shape placed on the overhead and covered with a transparent metric grid (all in cm²). Determine area as space covered by square units, e.g., area of a rectangle which has 4 rows of 7 cm² = 4 × 7 = 28 cm².	—square cm graph paper —transparency grid in cm² —variety of plane shapes
2. calculate the area of various geometric shapes using a transparent cm^2 grid		
3. calculate the area of a rectangle and square using cm^2 and m^2		
4. use the km^2 to measure large areas shown as scale drawings	Have a discussion on the unit for measuring large areas. Introduce scale drawing to make diagram of large areas.	—maps
5. select the appropriate unit for estimating and measuring area	See A 6, above.	

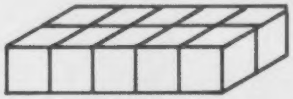
CONCEPTS, SKILLS AND OBJECTIVES | **TEACHER'S NOTES AND SUGGESTED ACTIVITIES** | **SUGGESTED MATERIALS**

C. Volume

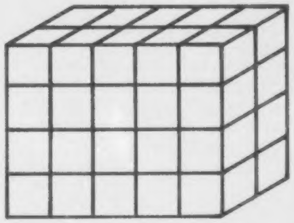
The student should be able to:

1. **recall the concepts of cm^3 and dm^3 by construction and measurement activities**
2. **estimate and measure volume selecting the appropriate unit**

Structures are built with cubes. The number of cubes gives the volume of the structure.



Determine volume in cm^3
$2 \times 5\ cm^3 = 10\ cm^3$



Build 4 layers using cm^3
$4 \times 10 = 40\ cm^3$
Volume of structure $= 40\ cm^3$
Attempting many problems leads to proficiency in finding volume and the formula for volume.

—centicubes
—cm squared graph paper

D. Capacity

The student should be able to:

1. **express millilitres as litres and vice versa, using decimal notation**
2. **estimate and measure capacity, selecting the appropriate unit**

Change linear grid in section A 3 to capacity grid. Note the similarity in the relationship of litre to millilitre and metre to millimetre.

e.g.,

ℓ	dl	cl	ml
1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
4	2	5	6

1 ℓ = 1000 ml
$\frac{1}{10}$ ℓ = 100 ml
4256 ml = 4ℓ 256 ml
= 4.256 ℓ

—litre measure (This can be made of a 2 qt. milk carton, which has a base of 10 cm × 10 cm. Measure 10 cm up; cut the carton around at 10 cm height.)

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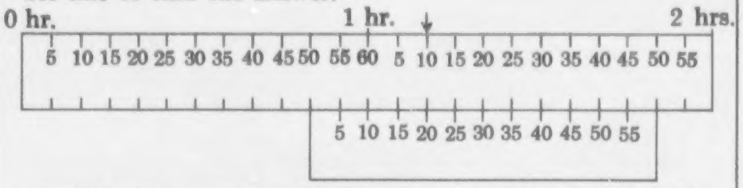
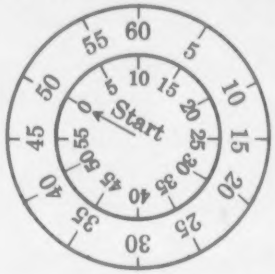
<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td></td><td>NOTE: The underlined units are those most commonly used. The consumer market also uses the $\frac{1}{2}\ell = 500$ ml and $\frac{1}{4}\ell = 250$ ml.</td><td>—construction of a ml (use cm squared paper)
—fold on lines to make a cube of 1 cm^3 (1 cm^3 holds 1 ml of water)</td></tr>
<tr><td>3. add and subtract capacity measures without and with regrouping</td><td></td><td></td></tr>
<tr><td>E. Mass
The student should be able to:
1. express grams as kilograms and vice versa, using decimal notation</td><td>The linear grid can be changed to a mass grid to show relationships between the various masses. For instance 10 kg = 10 000 g. Note also the similarity between mass, capacity, linear, decimal, and money systems.</td><td></td></tr>
<tr><td>2. estimate and measure mass, selecting the appropriate unit</td><td><table><tr><th>kg</th><th>hg</th><th>dag</th><th>g</th></tr><tr><td>1000</td><td>100</td><td>10</td><td>1</td></tr><tr><td>2</td><td>7</td><td>0</td><td>3</td></tr></table></td><td>—scales
—kilogram weight and other metric weights
—substitutes for kilogram weights in plasticine, bean bags, or sand</td></tr>
<tr><td>3. add and subtract mass measures without and with regrouping</td><td></td><td>—denominations of 1 kg, $\frac{1}{2}$ kg (500 g), $\frac{1}{4}$ kg (250 g), $\frac{1}{5}$ kg (200 g), 100 g, 50 g, 20 g can all be made in small plastic bags</td></tr>
<tr><td>F. Money
The student should be able to:
— solve money problems in addition, subtraction, multiplication, and division</td><td>See sections on money.</td><td>—money</td></tr>
</table>

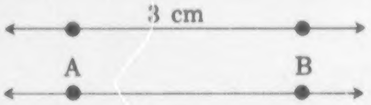
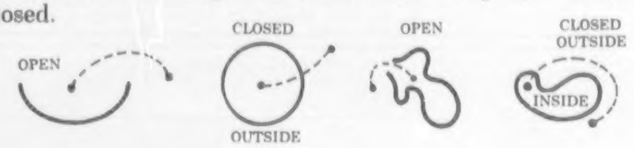
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
G. Time		
1. Elapse of Time		
The student should be able to:		
a. **estimate the time needed for doing a certain task** b. **compare the estimated time for doing a certain task to the known time required for another task**	This topic could be introduced by testing the accuracy of the much used statement, "I didn't have time", by estimating and then measuring the time it takes to do certain tasks, e.g., reading 5 pages in a book, doing 3 math problems, running around the school. The duration of a minute might be filled with activities such as running on the spot, counting his/her number of heart beats, counting his/her number of breaths, etc.	—stop watch —timer —pendulum
c. **measure the time needed for doing a certain task**	Estimate the time required to run around the school yard, walk to the store, clean the blackboards, etc., by comparing to known time lengths, such as the length of a recess, favourite television program, etc. These activities could then be measured. Some would lend themselves to graphing.	—watch
2. Units of Time		
The student should be able to:		
a. **explore and establish the relationships among second, minute, hour, day, week, month, year, decade, century**	Some problems in social studies could well be used to reinforce the concept of time (especially decades and centuries). Discussion of the origin of the calendar should lead to the concept of B.C. and A.D. in relation to time. The origin of the names of the months would help to create interest.	—clock faces —calendars
b. **record the date in SI format**	e.g., 1975 10 3 year month day (hour if applicable) SI advocates largest unit of time first.	—24-hour clock —digital clock
c. **read the time on** i. **a 24-hour clock** ii. **a digital clock**	e.g., 2:30 p.m. would be recorded as 14 30.	
d. **change minutes to hours and vice versa**	e.g., 50 minutes + 20 minutes = 70 minutes = 1 hour + 10 minutes	
e. **add and subtract units of time**	Several aids can be used to illustrate the above. A special number line could be used to work out the answer.	

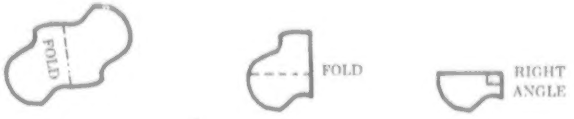
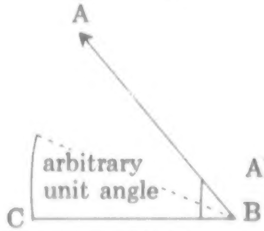
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	It will consist of a line of two units of 60 each divided in 5-minute intervals. A separate third unit strip equally divided in 5-minute intervals can be placed above or below the number line to find the answer.  0 hr. 1 hr. 2 hrs. 5 10 15 20 25 30 35 40 45 50 55 60 5 10 15 20 25 30 35 40 45 50 55 5 10 15 20 25 30 35 40 45 50 55 Another aid to use to arrive at the answer is a double disc clock, with five-minute intervals on each disc.  60 5 10 15 20 25 30 35 40 45 50 55 5 10 15 20 25 30 35 40 45 50 55 0 Start Top disc is movable (paper fastener through centre). Turn top disc to match "Start" with 50 (minutes) on the bottom disc. The 20 minutes to be added will correspond with 10 minutes over the 60 or over the hour, thus 60 + 10 or 1 hour + 10 minutes. Subtraction can also be illustrated using the two aids.	
EXTENSION: Rename a given time in our time zone, as a time in another Canadian time zone.	Telecasts of football games might be a springboard, e.g., if a game is played in Vancouver and starts at 9:00 p.m. (21 00) our time, what time is it in Vancouver? This topic might well be correlated with the teaching of social studies.	—maps showing time zones —globe
H. Temperature The student should be able to: **— read the Celsius thermometer above and below zero**	Integrate temperature with science activities such as measuring the different temperatures of water, ice, the body, and outdoor and indoor temperature.	—Celsius thermometers

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
IX. GEOMETRY		
A. Solid (3-D) and Plane (2-D) Geometry	Review section VI on geometry in grade 4.	
B. Line Segments		
The student should be able to:		
1. describe and illustrate a line segment 2. construct a line segment of a given length 3. label points on a line with letters and name the line segment	A line segment should be identified as part of a straight line. It has a point of origin and an end point. e.g.,  e.g.,	
4. find the midpoint of a line segment (informally)	This concept should be developed by folding a line segment (paper folding) and/or measurement.	—waxed paper —tracing paper
C. Open and Closed Curves		
The student should be able to:		
1. distinguish between simple open and closed curves 2. identify inside and outside regions 3. determine whether a given point is located in the inside region or the outside region	A relevant exercise might be to join two dots. If you can do this without crossing a line, the curve is open, if not, it is closed.  OPEN CLOSED OUTSIDE OPEN CLOSED OUTSIDE INSIDE	—pipe cleaners —rope —mazes —string —thread
D. Parallel and Perpendicular		
The student should be able to:		
1. identify parallel and perpendicular 2. locate parallel and perpendicular lines in solid 3-D models and plane 2-D models 3. draw a set of parallel lines 4. draw a line perpendicular to another line	Develop concept of parallel and perpendicular by using examples in the environment. e.g., sides of desks, door, window, railway tracks, etc.	—T-square

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Congruent Shapes and Line Segments		
The student should be able to:		
1. test for congruency of plane shapes by: a. sliding b. paper folding c. tracing	Congruency can be tested by superimposing one shape onto another by sliding, paper cutting, tracing, measuring, etc.	—waxed paper —tracing paper —MIRA —mirror —transparency —overhead projector
2. test for congruency of line segments by measurement		
3. reproduce congruent plane shapes		
4. reproduce congruent line segments		
F. Angles		
The student should be able to:		
1. compare given angles with right angles	These provide readiness for the introduction of "degree" as a standard unit of measure of an angle and for the use of the protractor. *To make a right angle* Fold paper once. Fold again so that the one edge of the first fold line corresponds with the opposite edge of the first fold line. 	—folding paper —model right angle
2. measure angles using an arbitrary angle as the unit of measure	 ABC = 2 units	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
G. Polygons		
The student should be able to:		
1. classify the various regular polygons by the number of equal sides and equal angles	NOTE: A regular polygon is a simple polygon with all angles equal and all sides equal.	—models
a. three sides — equilateral triangles b. four sides — squares c. five sides — pentagons d. six sides — hexagons e. eight sides — octagons	In measuring the angles, at this stage, it is recommended that students trace and compare angles.	
2. verify that regular polygons have equal angles	By tracing and folding.	—waxed paper
H. Right Triangle		
The student should be able to:		
1. sort and classify triangles as right angled or non-right angled	Explain folding non-right triangles into two right triangles.	
2. construct a right angle triangle using graph paper, geopaper, geoboards, paper folding, etc.	This should be approached through the use of graph paper, geopaper, geoboards, and paper folding. *Compass constructions should not be introduced at this time.*	—geoboards and elastics —graph paper —geopaper
I. Symmetry		
The student should be able to:		
1. recognize symmetry in nature and in the environment	Children should be encouraged to look for symmetry in the environment: leaves, snowflakes, flowers, animals, people, cars, buildings, furniture, and fabric designs in their clothing.	—real objects, where possible —pictures of objects
2. recognize symmetry in geometric shapes	See grade 4 for some examples. Explore further with regular polygons and triangles.	
3. test shapes for symmetry and identify lines of symmetry	This may be approached through the following: i. sight and drawing — merely an arbitrary method based upon an individual's judgement. ii. tracing one side, cutting and matching to the other. iii. folding one side onto the other. iv. using a transparent mirror — covering the part of the shape behind the mirror with the image.	—transparency —MIRA —mirror

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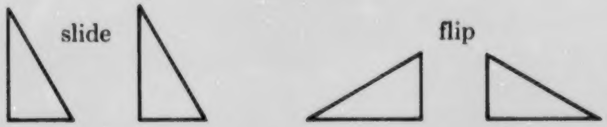
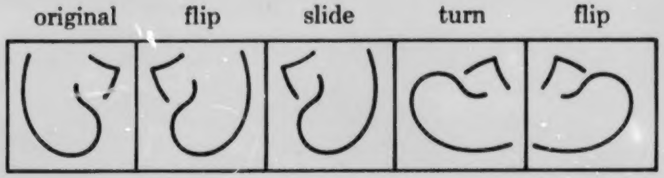
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. construct symmetric shapes	Students can be involved in tiling (tessellating) different shapes to produce symmetric designs.	
J. Slides, Flips and Turns The student should be able to:	See notes on program implementation and the grade 4 section for an explanation and review of slides, flips and turns.	
1. identify the motion (slide, flip, or turn) represented in a diagram	e.g., 	
2. construct the image of a shape after a slide, flip or turn	This can be done by tracing the object, using geoboard or geopaper.	
3. find examples of slides, flips, and turns in the environment	e.g., Slides — slide, inclined plane, skiing, sled Turns — ferris wheel, merry-go-round, swing, door Flips — mirror images, turning pages (blank), water reflections, ambulance sign	
4. create designs by sliding, flipping and turning shapes		
X. GRAPHING Introductory Note	The skills of graphing and the interpretation of graphs has been introduced in earlier grades and reinforced in mathematics as well as in other subject areas. An informal approach was used at the primary level where emphasis was on the concrete graph, the pictograph, and the bar graph where one symbol represented one unit of data. In grade 4 this was extended to one symbol representing more than one unit of data and the line graph was introduced. In grade 5, graphing will be extended to include ordered pairs.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: It is suggested that students should be involved in a review of the construction of and interpretation of graphs. Use an interesting topic (probably from other subject areas to make the review more relevant).	
	Encourage students to look for graphs in magazines and newspapers for discussion and interpretation.	
A. Steps In Graphing The student should be able to:		
1. a. state what they are graphing b. state why they are graphing	NOTE: See grade 4, section VIII, for examples to accompany each step.	
2. gather information or data in a variety of ways	Data may be obtained through measurement activities, surveys, and research.	
3. organize the information or data in a useful manner		
4. select a suitable type of graph to illustrate the data		
5. select a suitable scale to best illustrate the data on the graph		
6. construct the graph		
7. interpret the graph and draw some conclusions about the data		

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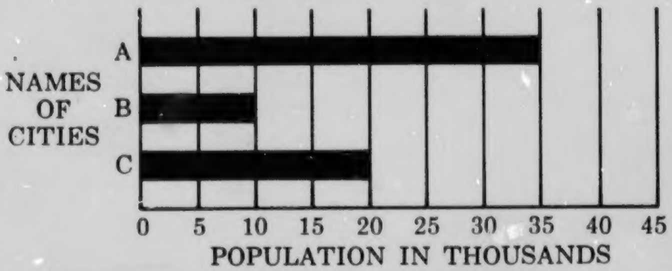
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Types of Graphs		
1. Concrete		
The student should be able to:		
a. construct a concrete graph	See grade 1, section V.	—concrete objects
b. interpret and report on a concrete graph		
c. title the graph		
2. Pictograph		
The student should be able to:		
a. construct a pictograph using one symbol for each unit of data or one symbol for more than one unit of data	See grade 4, section VI.	—chart paper
b. interpret and report on the results illustrated in a pictograph		
c. title the pictograph		
3. Bar Graph		
The student should be able to:		
a. select the scale	See grade 4, section VI.	—graph paper
b. label the axes	Students should be involved in selecting the scale (simple scales) and in labelling the axes. They should be exposed to vertical and horizontal forms of the bar graph.	
c. construct a vertical or a horizontal bar graph to represent a set of data		
d. interpret and report on the results illustrated in a bar graph		
e. title the bar graph		

CONCEPTS, SKILLS AND OBJECTIVES

4. Number Pairs (Ordered Pairs)

The student should be able to:

a. name the axes:
- **horizontal and vertical**
- **X-axis and Y-axis**

b. label the points on the axes

c. locate on a graph a point represented by a pair of numbers (ordered pair) — first quadrant only

d. describe a point by naming the ordered pair which the point represents

5. Line Graphs

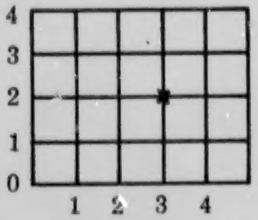
The student should be able to:

a. select the scale
b. label the axes
c. construct the line graph
d. interpret and report
e. title the graph

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Where Am I

If classroom desks are set up in rows and lines, an activity locating each student's desk could provide an interesting and relevant introduction to graphing ordered pairs.



(3, 2)
3 over and 2 up

Activities may involve construction of pictures or designs by connecting points indicated by ordered pairs.

Other examples:

1. seating plan in an auditorium
2. seating plan in a station
3. road maps
4. gym activities

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
146	147	147	148	149	149	150	151	151	152	152	153

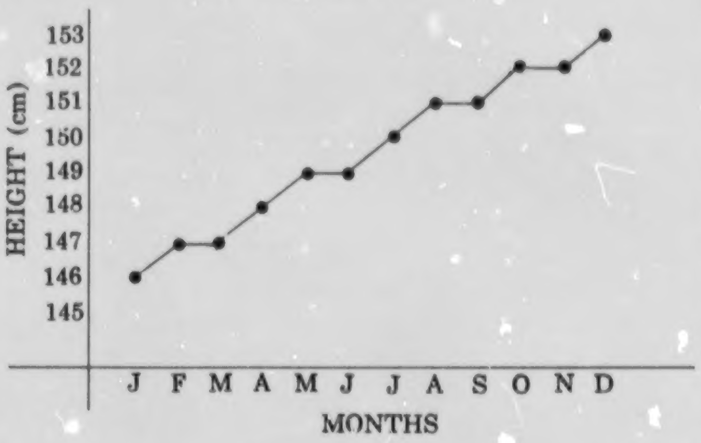
JOHN'S HEIGHT (cm)

SUGGESTED MATERIALS

—grid paper
—games — "Battleship", "Vectors"
—maps

NOTE: The game "Battleship" should be suitably adapted.

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	JOHN'S HEIGHT GROWTH  NOTE: Line graphs should only be used to report on data which is continuous and which indicates changes or tendencies. See grade 4, section VIII, for another line graph. NOTE: Combined line and bar graphs are used in some textbooks to illustrate climatic relationships.	—geoboards —string —graph paper
XI. PROBLEM SOLVING **A. Oral Problems** **The student should be able to:** **1. solve simple "oral problems" quickly and accurately** **2. explain how he/she obtained the solution by:** **a. using concrete material** **b. using a diagram** **c. using a number sentence**	Discussion of oral problems is a good introduction for further work in written problems. Small groups are preferable for such discussion. Encourage use of material and/or diagrams to interpret or represent the problem. Students should also be given the opportunity to make up problems for given number sentences.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Computation Problems		
The student should be able to:		
1. **solve textbook problem exercises based on graphs, diagrams, pictures, charts**	"Computation problems" are featured in most of the approved texts. They involve using data from a graph, chart, etc., to provide solutions for a variety of questions.	
2. **explain how he/she obtained the solution**		
C. Word Problems		
The student should be able to:		
1. **solve "word problems" involving one and two steps**	The expectations involving word problems are outlined under headings related to basic operations with whole numbers, fractions and decimals. NOTE: A two-step problem is described as a problem requiring two different operations for its solution.	
2. **analyze a problem**	*Sample Problem* Mary earned $12.00 per week from a paper route. How much would she earn in 48 weeks?	
a. **interpret the word problem**	The problem is presented and discussed. Certain vocabulary words are interpreted if necessary. How could we represent the problem visually (diagram, materials, etc.)? What is the question asked?	
b. **illustrate the problem**	To illustrate the problem, you could use concrete material, representative material, or draw a picture or diagram.	
c. **decide the procedure for solving the problem**	Find useful information which will help you to find the solution. How will you use the information? Look for words, or re-read the problem to help you decide on an operation.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
d. **estimate the solution and then complete the procedures (operations) to solve the problem**	Estimate, if feasible, by rounding off. This should be quick mental work. The answer could be recorded for later reference. Write the open number sentence, i.e., 48 × 12 = n. Estimate — 500. Solve the number sentence (compute) $\begin{array}{r} 48 \\ \times\ \underline{12} \\ 96 \\ \underline{48\ } \\ 576 \end{array}$	
e. **check the solution**	Does it answer the question? Is the answer reasonable when compared with the estimated answer? Is the answer correct? Check by inverse operations (if this is not too complicated).	
f. **write the conclusion in statement form**	Write the solution in a brief statement form, i.e., 48 × 12 = 576. She earned $576. A brief discussion may lead to the fact that some children did not use the same procedure, but had the same solution. NOTE: Although the above are suggested steps in teaching problem solving they are by no means a must. However, they could enable many children to tackle problems in a more meaningful way.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
ENRICHMENT:		
1. Solve problems or puzzles involving mathematical concepts.	Projects should feature challenging situations where students can use concrete materials, graphs, charts, patterns, etc., in the search for solutions. Some examples include: riddles, Nim games, tangrams, paper folding, magic squares, number patterns and sequences.	
2. Make observations and draw resulting conclusions from activities and data related to mathematics methods, theorems, etc., (guided discovery).	The following recommendations apply to a teacher using a "guided discovery" approach for projects: a. Provide a variety of open-ended problems along with problems requiring specific solutions. A strong attempt should be made to provide real-life situations, relevant to the students. b. Prepare precise directions (along with a list of references) that will enable students to interpret and solve problems independently. c. Provide problems that will require student involvement with materials. These materials should be readily available to the student at the time he/she is working with the problem. d. The student should be required to illustrate his/her data via graphs, diagrams, charts, computations, etc. This also provides the teacher with an opportunity to set adequate standards of presentation, i.e., correct graphing procedures, spelling, lettering, measuring, etc. e. The teacher should supervise such activities, carefully interjecting with leading questions. f. Students' work should be displayed in the classroom and findings should be discussed with the class, or with groups within the class. g. Suggested themes may be found in the grade 6 section.	

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. NUMBER — TEN-DIGIT NUMBERS		
Introductory Note	Ten-digit numerals are being introduced formally. The intent here is to give the student a better insight into the structure of our numeration system, i.e., the place value concept:	

ONS		THOUSANDS			ONES		
ns	ones	hunds.	tens	ones	hunds.	tens	ones
		4	1	3	7	5	8

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
A. Base 10 and Place Value The student should be able to:		
1. read and write base 10 whole numbers up to ten places including zero as a place holder	In metric editions of some textbooks the comma has been removed from period groupings, e.g., 54,265 and replaced with a space, 54 265, and is read as 54 thousand two hundred sixty-five. Where 4 digits are used it is *not* necessary to leave a space, i.e., 5643. This is in compliance with SI metric specifications.	
2. read and write decimals up to three places (refer to grade 5) **3. give the value of any digit in a number**	Initial activities with popsicle sticks, elastic bands, multi-base blocks, place value charts, currency, Unifix materials, etc., provide concrete experiences in grouping and developing the base 10 concept. At year 6, most students will be able to perform place value exercises using an abacus, place value board, shopping calculators, odometers, and blackboard charts. These devices are helpful in expressing a number in expanded notation.	—popsicle sticks —elastic bands —tickets (tags) —straws —multi-base blocks —metric rulers —currency —odometer —abacus —place value board —place value chart —shopping calculator —Cuisenaire rods —Unifix materials —gummed seals —bottle caps —number line —base machine

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	The following games lead to a better understanding of and provide reinforcement for the concepts of place value and the recording of numbers. *Pick to Win* (place value game #1) The teacher makes 20 flashcards and prints the numerals 0-9 (one numeral on each card, each being used twice). To play the game the teacher places a series of blanks on the blackboard. The students copy them on paper. e.g., ____ ____ ____, ____ ____ ____ A student is asked to select a card and call it out to the class. (The cards should be placed face down for this game.) Each student is asked to place the numeral in a blank so that he/she may eventually get the highest possible number. Once a number is placed on a blank it may not be changed. After sufficient cards have been selected by the students (in this case, 6 cards), each student should have all the blanks filled. Ask *one* student to read his/her number. Does anyone have a higher number? Ask another. This should continue until you have the highest number. Each child must correctly read the number (not the digits) in order to win. After the winner or winners have been declared, is there a higher possible number? Variations may include decimals, lowest number, different bases, whole number and fraction operations. Dice (polyhedra) or spinners may also be used.	
	Big Number (place value game # 2) Use a pack of cards numbered 0-9 (several of each number). The dealer deals 3 cards to each player (number of cards can be increased). The players must then turn their cards face up in the order in which they were dealt — left to right. The remainder of the deck is placed in the middle. One card from the deck is turned face up beside it (discard pile). Beginning with the dealer, each child has 3 choices: a. keep the cards which were dealt b. exchange any card for the face up card in the discard pile	—blank playing cards —manilla tag

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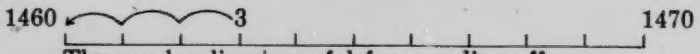
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	c. choose the top card in the deck (turned down) and use it to replace any one of his/her three cards. His/her "old" card goes face up in the discard pile. The winner is the person who makes the highest numeral after 3 rounds. ENRICHMENT: Relate to place value in other base systems. Operations need not be stressed.	
B. Expanded Notation **The student should be able to:** **– write numbers in expanded form**	$5417 \longrightarrow 5000 + 400 + 10 + 7$ $\longrightarrow 5000 + 400 + 10 + 7$ $\longrightarrow 5(1000) + 4(100) + 1(10) + 7(1)$ $\longrightarrow 5(10 \times 10 \times 10) + 4(10 \times 10) + 1(10) + 7(1)$	
C. Exponents **The student should be able to:** **– interpret and write numbers (tens) in exponential form**	$5417 \longrightarrow (5 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (7 \times 10^0)$ EXTENSION: Use exponents as they relate to place value in other bases. $313_4 \longrightarrow (3_4)^2 + (1_4)^1 + (3_4)^0$	
D. Renaming Numbers **The student should be able to:** **– rename a number in many ways**	A number can be renamed in many ways, e.g., $36 = 35 + 1 = 4 \times 9 = 30 + 6 = 40 - 4 = 7 \times 5 + 1 = 2 \times 2 \times 3 \times 3 = \frac{1}{2}$ of 72, etc. Place a number on the board and have each student rename it in a different way. This will facilitate the understanding of "number".	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
E. Regrouping Numbers (Renaming by Place Value) The student should be able to: — regroup a number by tens	The following could be done orally. e.g., $15 + 18 = 10 + 10 + 5 + 8$ $= 20 + 13$ $= 30 + 3$ $= 33$ $\begin{array}{r\|r} 1 & 5 \\ +1 & 8 \\ \hline 2 & 13 \\ 3 & 3 \end{array} \longrightarrow \begin{array}{r\|r} 1 & 5 \\ +1 & 8 \\ \hline 1 & 3 \\ 2 & \\ \hline 3 & 3 \end{array} \longrightarrow \begin{array}{r} 15 \\ +18 \\ \hline 33 \end{array}$ This will facilitate the understanding of operations.	—Dienes blocks —place value chart —abacus —beads
F. Rounding Off The student should be able to: 1. round off whole numbers using any one of the nine possible digits in a ten-digit number 2. round off decimals to any one of three places	e.g., round off 1463 to the nearest ten.  The number line is useful for rounding off. NOTE: When rounding off a "5", the student should be directed to raise it to the next highest number. e.g., 35 → 40 450 → 500	—number line —scales or rulers graduated in cm and mm
G. Equalities/Inequalities The student should be able to: — use the appropriate symbol (<, =, ≠, >) to make a number sentence true	$7 + 9 \bigcirc\!\!\!\!= 11 + 5$ $27 \div 3 \bigcirc\!\!\!\!> 4 \times 2$	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
II. OTHER NUMERATION SYSTEMS		
ENRICHMENT: Relate other numeration systems to our Hindu-Arabic system.	Examples may include the following systems: Egyptian, Mayan, Chinese, Greek, Roman, Babylonian.	
III. NUMBER THEORY **A. Patterns** **The student should be able to:**		
1. identify, construct and complete simple patterns using concrete materials	Please refer to notes on program implementation for discussion on patterns. If students have a limited background with patterns, some time should be devoted to introducing them to the concept.	—counters (different shapes, colours, sizes, etc.)
2. identify, construct, and complete simple pictorial patterns		
a. natural	Some attention should be given to the existence of natural patterns such as stellar constellations, cyclic phenomena, animal habits, markings, spirals, etc.	—pictures of stars and animals —maps (streets, highways)
b. man-made	Music (rhythm), art, urban development — streets, wallpaper, wrapping paper, architecture, etc., are just a few examples of man-made patterns. Related activities exist in work with symmetry, slides, flips, turns, tessellations and tiling.	—recorded music —art pieces —professional photos —wallpaper —clothing (textiles)
c. numerical	Informal discovery sessions should be conducted with the hundred chart and the product grid. After students have had sufficient practice in finding patterns they should be directed to activities where they have to supply the missing numbers to complete the pattern. It is recommended that students investigate the various patterns in the hundred chart.	—pegboards —wrapping paper —graph paper —transparencies —overhead projector —coloured pencils —bead patterns —number lines

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

SUGGESTED MATERIALS

Patterns (Hundred Grid)

— count by 2's, 3's, 4's, etc.

— successive differences along diagonals, etc.

3 — 14 — 25 — 36 — 47, etc.
11 11 11 11

8 — 17 — 26 — 35 — 44, etc.
9 9 9 9

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

HUNDRED CHART

—overhead projector
—transparencies

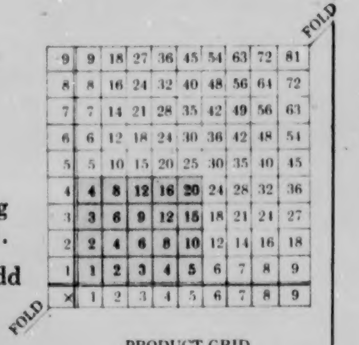
Patterns (Product Grid)

i. The product grid may be used as an area grid. Note the shaded section ($4 \times 5 = 20$).

ii. Examine for the symmetry pattern of the table by folding along the diagonal (as shown).

iii. Search for patterns such as odd numbers, square numbers, successive differences, etc.

iv. Discover an illustration of the commutative and associative properties, inverse operations, etc., in the product grid.



9	9	18	27	36	45	54	63	72	81
8	8	16	24	32	40	48	56	64	72
7	7	14	21	28	35	42	49	56	63
6	6	12	18	24	30	36	42	48	54
5	5	10	15	20	25	30	35	40	45
4	**4**	**8**	**12**	**16**	**20**	24	28	32	36
3	**3**	**6**	**9**	**12**	**15**	18	21	24	27
2	**2**	**4**	**6**	**8**	**10**	12	14	16	18
1	**1**	**2**	**3**	**4**	**5**	6	7	8	9
×	1	2	3	4	5	6	7	8	9

PRODUCT GRID

—graph paper
—transparencies
—overhead projector
—coloured pencils

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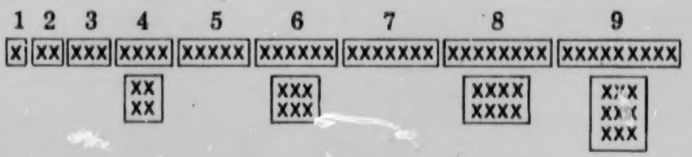
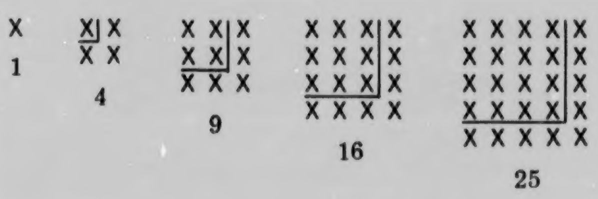
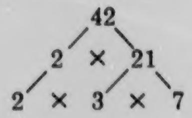
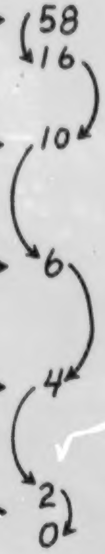
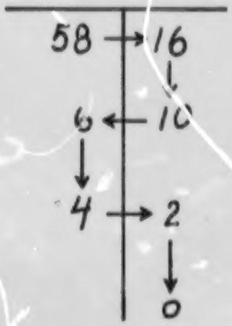
504

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: See discussion on addition grid patterns in grade 5 section. It is essential that many copies of the product grid be made available to the students to avoid trying to identify too many patterns on one grid so as not to be confusing for the student.	
3. discover and identify special patterns as they relate to: **a. rectangular numbers**	*Rectangular Numbers* The product grid or an array may be used to build rectangular numbers.  Composite numbers can be illustrated by at least two rectangular arrays. See section on Primes/Composites.	—counters (different shapes, colours, sizes, etc.) —pipe cleaners —string —geoboards —pegboards —pattern blocks
b. square numbers	*Square Numbers* Students can be directed to use the grid or an array (as shown below) to build square numbers. e.g.,  NOTE: Find the successive differences of the square numbers. Can you predict the next square number in the series?	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. oblong numbers	*Oblong Numbers* The product grid or an array may be used to build oblong numbers (length is one unit longer than width): e.g., X X 2 X X X X X X 6 X X X X X X X X X X X X 12 X X X X X X X X X X X X X X X X X X X X 20 NOTE: Find the successive differences. Is there a pattern in the differences? Can you predict the next number?	
d. triangular numbers	*Triangular Numbers* Use triangular grid paper or an array to illustrate triangular numbers. e.g., X X X 3 X X X X X X 6 X X X X X X X X X X 10 X X X X X X X X X X X X X X X 15 X X X X X X X X X X X X X X X X X X X X X 21 NOTE: Examine the successive differences — 3, 4, 5, 6 . . . Can the 10th term be predicted? ENRICHMENT: Some students may be encouraged to explore with other number shapes, i.e., pentagonal, cubic, etc.	—counters —string —geoboards —pegboards
4. discover patterns in magic squares	Students should be given opportunities to work with magic squares in the search for patterns.	
5. recognize patterns in numerical sequences 507	Students should be directed into expressing the patterns in numerical sequence, e.g., 1, 4, 16, 25, 36 . . .	508

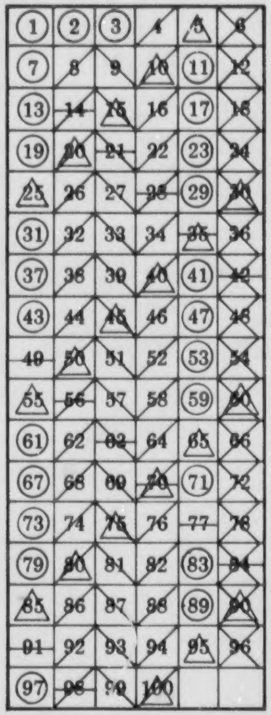
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	ENRICHMENT: Students may be encouraged to explore other sequences, i.e., Fibonacci, Pascal, Elevens, Euler lines, etc.	
B. Even and Odd Numbers **The student should be able to:**		
1. show the difference between even and odd numbers by grouping by 2's	This section should only be a review at this time.	—graph paper
2. predict the sum of: **— two even numbers** **— two odd numbers** **— even and odd numbers**	See discussion in grade 5 section.	
C. Factors and Multiples **The student should be able to:**		
1. find all the factors of a given number	Development of factoring can be approached using the following techniques: i. Product Grid	—graph paper
	ii. Sets and factor pairs Pairs of facts of 84: 1 × 84, 2 × 42, 3 × 28, 4 × 21, 6 × 14, 7 × 12 Sets of facts of 84: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84	
	iii. Factor Tree  NOTE: Most textbooks contain good descriptions of activities with factor trees.	
	iv. See section to follow on Primes and Composites.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: It is important to remember that the number of factors of any number is finite.	
2. find common factors of two numbers	e.g., 48 → 1, 2, 3, 4, 6, 8, 12, 16, 24, 48 18 → 1, 2, 3, 6, 9, 18 Common factors — 1, 2, 3, 6	
3. find the greatest common factor (G.C.F.) of two numbers	This is a most important concept to develop in preparation for reduction of fractions and finding a common denominator. The set of factors for 48 and 18 can be identified as in the example above. In the example, the number 6 is, of course, the greatest common factor.	
ENRICHMENT: **Use the Euclidean algorithm to find the G.C.F. of any two nonprime numbers.**	e.g., Given two composite numbers, 58 and 16, find the G.C.F. *Step # 1* Divide 58 by 16 → 3 remainder ⑩ *Step # 2* Divide 16 by 10 → 1 remainder ⑥ *Step # 3* Divide 10 by 6 → 1 remainder ④ *Step # 4* Divide 6 by 4 → 1 remainder ② *Step # 5* Divide 4 by 2 → 2 remainder ⓪   NOTE: The last number to appear before the 0 is the G.C.F. (check it).	

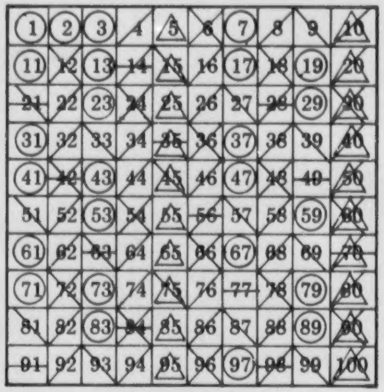
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. express multiples of a given number	The student may be directed to the product grid (multiplication tables) for review of multiples.	
5. find common multiples of two numbers	Multiples of 4 are 4, 8, ⑫, 16, 20, ㉔, 28, 32, ㊱, 40 Multiples of 6 are 6, ⑫, 18, ㉔, 30, ㊱, 42 . . . Common multiples — 12, 24, 36 . . . NOTE: It is important to remember that multiples are *infinite* in number. From the example above, 12 is the lowest common multiple (L.C.M.). NOTE: This concept is readiness for raising or changing fractions to higher terms.	
D. Primes/Composites The student should be able to:		
1. list all prime numbers between 1 and 100	*Prime Number*—is one which has only two factors, i.e., itself and one.	—Cuisenaire rods —Dienes multi-base blocks
2. list all composite numbers between 1 and 100	*Composite Number*—is one which has more than two factors.	—counters
	Eratosthenes' Sieve A hundred grid (as illustrated) will reveal some interesting patterns when the following activity has been completed: i. Draw a diagonal (/) through all the multiples of 2. Note the pattern. ii. Draw a diagonal (\\) through all the multiples of 3. Note the pattern. iii. Draw a triangle (△), or use a coloured marker, over all the multiples of 5. Note the pattern. iv. Draw a line (–), or use a coloured marker, through all the multiples of 7. Note the pattern.	—graph paper —coloured pencils —blank 100 grid —overlays for the 100 grid showing: a. multiples of 2 b. multiples of 3 c. multiples of 5 d. multiples of 7 etc. —graph paper —coloured pencils

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

*The remaining (circled) numbers are primes. Is there a pattern?



1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
49	50	51	52	53	54
55	56	57	58	59	60
61	62	63	64	65	66
67	68	69	70	71	72
73	74	75	76	77	78
79	80	81	82	83	84
85	86	87	88	89	90
91	92	93	94	95	96
97	98	99	100		



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

NOTE: Location of prime numbers.

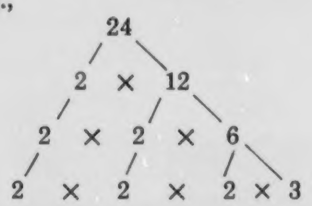
—graph paper

3. use the factor tree to find the factors of a number

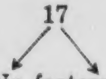
Factor Tree

The last row in a factor tree illustrates the prime factors of a number.

e.g.,

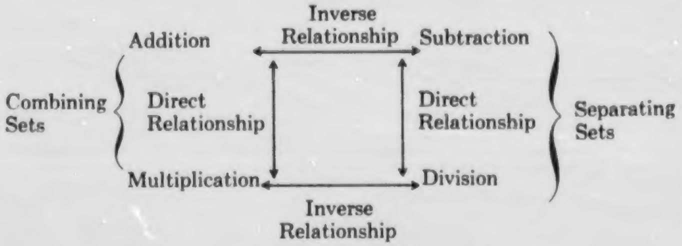


(Composite)



No factors other than 1 and 17 (prime).

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Any composite number can be expressed as the product of its prime factors.	
E. Rules of Divisibility The student should be able to, without performing division, tell if any number (up to 6 digits) is divisible by:	NOTE: The ability to tell at a glance whether a number is divisible by 2, 3, 4, 5, 6, 9, or 10 is a real asset in determining the factors of a number. The students should not be told what the rules are but encouraged to investigate, with some direction, the special patterns which are evident in the first ten multiples of the above numbers.	
— 2, 4, 5, 10	Review rules of divisibility for 2, 4, 5, and 10. See grade 4 section.	
— 3	A number is divisible by 3 if the sum of the digits is divisible by 3, e.g., 417.	
— 6	A number is divisible by 6 if it is divisible by 2 and 3, e.g., 414.	
— 9	A number is usually divisible by 9 if the sum of its digits is divisible by 3, e.g., 4131.	
	Following discovery, the rules should be maintained through application rather than rote memorization.	
IV. **OPERATIONS (WHOLE NUMBERS)**		
Introductory Note	The following will illustrate the inter-relationships among the whole number operations:  Inverse Relationship Addition Subtraction Combining Sets Direct Relationship Direct Relationship Separating Sets Multiplication Division Inverse Relationship	—blank cards —blank dice —dice
517		518

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES

A. Mathematical Properties

For whole numbers, the student should be able to:

1. apply the commutative property of addition and multiplication
2. apply the associative property of addition and multiplication
3. apply the property of zero (identity element for addition)
4. apply the property of one (identity element for multiplication)
5. apply the distributive property

Addition and Subtraction

B. Addition

1. **Meaning**

The student should be able to:

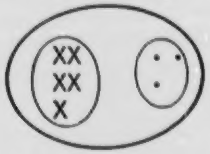
- exemplify concretely or pictorially the meaning of addition

TEACHER'S NOTES AND SUGGESTED ACTIVITIES

Addition	Multiplication
$2 + 3 = 3 + 2$	$2 \times 3 = 3 \times 2$
$(2 + 3) + 4 = 2 + (3 + 4)$	$(2 \times 3) \times 4 = 2 \times (3 \times 4)$
$2 + 0 = 2$ (zero is the identity number for addition)	
	$2 \times 1 = 2$ (one is the identity number for multiplication)
$2 \times (3 + 4) = (2 \times 3) + (2 \times 4)$	

TERMINOLOGY NEED NOT BE STRESSED.

The meaning of addition can best be reviewed by having the students join sets to form a new set.



Addition is represented by the union of disjoint sets.

$5 + 3 = 8$

SUGGESTED MATERIALS

—popsicle sticks
—elastic bands
—tickets (tags)
—straws
—bottle caps
—multi-base blocks
—equalizer balance
—metric rulers
—number line
—currency
—abacus
—place value board
—place value chart
—shopping calculator
—Cuisenaire rods
—Unifix materials
—game materials
—games

—"Krypto"
—"The Winning Touch"
—"Tuf"
—"Heads Up"

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Basic Facts The student should be able to: — **recall with proficiency all basic addition facts**	Each student should exhibit quick and accurate recall of the addition table. Regular application, quizzes, games, and number line activities will assist in reinforcing these important facts. *Drill Games and Puzzles* a. *Pick to Win* — see teaching notes at beginning of grade 6 section re procedures. This is a variation of the place value game. b. *Magic Squares* — can be found in most approved texts. *The Arithmetic Teacher* (December 1974) contains an article (pages 288-292) designed to assist teachers in making magic squares for their classroom.	—number tutors —"Veri-tech" —attribute blocks —seeds, small blocks, pebbles —string, pipe cleaners —overhead projector
3. Addition with Regrouping The student should be able to: a. **use expanded notation to regroup**	Expanded notation — this is to review the addition algorithm. $\begin{array}{rcrcrcr} 794 & = & 700 & + & 90 & + & 4 \\ +\ 357 & = & 300 & + & 50 & + & 7 \\ \hline & = & 1000 & + & 140 & + & 11 \\ & = & 1000 & + & 150 & + & 1 \\ & = & 1100 & + & 50 & + & 1 \\ =1000 & + & 100 & + & 50 & + & 1 \\ =1151 & & & & & & \end{array}$	—Dienes blocks —place value charts —abacus —function machine

Concepts and Skills are indicated in Bold Face.

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>b. use the place value grid to regroup</td><td><i>Place Value Grid</i>
<table>
<tr><th></th><th>Th</th><th>H</th><th>T</th><th>O</th></tr>
<tr><td></td><td>4</td><td>8</td><td>4</td><td>8</td></tr>
<tr><td>+</td><td>2</td><td>5</td><td>6</td><td>4</td></tr>
<tr><td></td><td>6</td><td>13</td><td>10</td><td>12</td></tr>
<tr><td></td><td>6</td><td>13</td><td>11</td><td>2</td></tr>
<tr><td></td><td>6</td><td>14</td><td>1</td><td>2</td></tr>
<tr><td></td><td>7</td><td>4</td><td>1</td><td>2</td></tr>
</table></td><td></td></tr>
<tr><td>4. Column and Horizontal Addition

The student should be able to:</td><td></td><td></td></tr>
<tr><td>a. rewrite an addition sentence as a column addition algorithm</td><td>Rewriting numbers from horizontal form to vertical form is a valuable exercise.

423 + 41 375 + 719 422
$$\begin{array}{r} 423 \\ 41\ 375 \\ +\ 719\ 422 \\ \hline \boxed{} \end{array}$$</td><td>—place value board</td></tr>
<tr><td>b. add a group of numbers of up to 6 digits each</td><td>$$\begin{array}{r} 637\ 215 \\ 3\ 876 \\ 730 \\ +\ 99\ 798 \\ \hline 741\ 619 \end{array}$$</td><td></td></tr>
<tr><td>5. Addition of Money

The student should be able to:</td><td></td><td></td></tr>
<tr><td>— add sums of money to the limits of #4

523</td><td>This will provide a meaningful application for the addition algorithm.

NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.</td><td>524</td></tr>
</table>

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

6. Rounding Off for Estimation

The student should be able to:

— round off numbers to multiples of 10 and apply to addition

Rounding off and the addition of rounded numbers should be done orally or mentally.

78 + 53 = Think 80 + 50 is $\boxed{130}$ and the 130 is recorded or written.

7. Checking Addition

The student should be able to:

a. use the commutative property or associative property in checking column and horizontal addition

Commutative

$$\begin{array}{r} 15\ 635 \\ +\ 7\ 947 \\ \hline 23\ 582 \end{array} \qquad \begin{array}{r} 7\ 947 \\ +\ 15\ 635 \\ \hline 23\ 582 \end{array}$$

72 + 33 = 33 + 72
105 = 105

Associative

$$\begin{array}{r} 29 \\ 37 \\ +\ 56\downarrow \\ \hline 122 \end{array} \qquad \begin{array}{r} 29\uparrow \\ 37 \\ +\ 56 \\ \hline 122 \end{array}$$

Add Down   Add Up

$$\begin{array}{rcl} (29 + 37) + 56 & = & 29 + (37 + 56) \\ 66 + 56 & = & 29 + 93 \\ 122 & = & 122 \end{array}$$

b. group by tens to check column addition

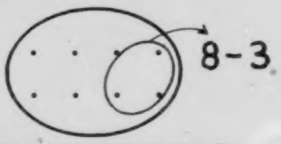
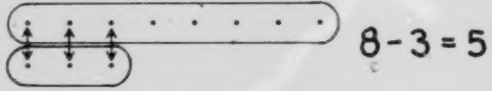
$$\begin{array}{r} {}^{2\,2} \\ 741 \\ 36 \\ 59 \\ +\ 68 \\ \hline 904 \end{array}$$

ENRICHMENT: Check the answer obtained by addition using the "casting out nines" method.

Casting Out Nines

$$\begin{array}{rcccccc} & & 1+5+4+9+6 & & 2+5 & & \\ 15\ 496 & \to & 25 & \to & 7 & \to & 7 \qquad 7+0+2=9\to\textcircled{0} \\ 6\ 543 & \to & 18 & \to & 9 & \to & 0 \\ +\ 91\ 496 & \to & 29 & \to & 11 & \to & 2 \\ \hline 113\ 535 & \to & 18 & \to & 9 & \to & \textcircled{0} \end{array}$$

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
8. Word Problems The student should be able to: — use number sentences to solve one- and two-step word problems	One-Step — see previous work, e.g., grade 4. Two-Step — e.g., four boys at the Tigers Club decided to earn some money to buy a wagon for $12.00. They delivered fliers and earned 2¢ per flier. Jason delivered 152 fliers, Dean — 165, Graham — 85, and John — 108. How much money was earned by the boys? (152 + 85 + 165 + 108) × 2 = ☐	
EXTENSION: Use number sentences to solve problems of more than 3 steps.	See section on problem solving.	
C. Subtraction **1. Meaning** The student should be able to: — illustrate concretely and pictorially the meaning of subtraction	Review: The meaning of subtraction can be illustrated using the following techniques: a. removal of a subset  b. comparison  The unmatched subset illustrates the difference. c. missing addends 3 + ☐ = 8 d. inverse of addition 16 — 9 = 7 7 + 9 = 16	—popsicle sticks —elastic bands —tickets (tags) —straws —bottle caps —multi-base blocks (base 10) —equalizer balance —number line —currency —abacus —place value chart —place value board —shopping calculator —Cuisenaire rods —Unifix materials —base machine —"Veri-tech" —number tutors

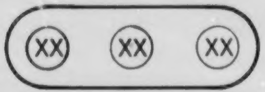
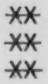
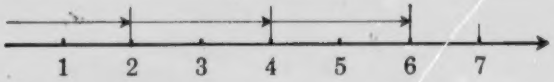
5:7

5:8

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Subtraction with Multiples of 10 The student should be able to: — subtract 10 and/or a multiple of 10 from a given number	475 — 10 = 398 — 40 = 5467 — 200 =	—popsicle sticks —elastic bands —tickets (tags) —straws —bottle caps —multi-base blocks (base 10) —equalizer balance —number line —currency —abacus —place value chart —place value board —shopping calculator —Cuisenaire rods —Unifix materials —base machine —"Veri-tech" —number tutors
3. Subtraction with Regrouping The student should be able to:		
a. regroup using expanded notation	*Expanded Notation* This is to review the subtraction algorithm. $\begin{array}{rcccc} 412 & & 400+10+2 & & 300+100+12 \\ -\underline{294} & \longrightarrow & \underline{200+90+4} & \longrightarrow & \underline{200+\ 90+\ 4} \\ 118 & \longleftarrow & & & 100+\ 10+\ 8 \end{array}$	
b. regroup using the place value grid	*Place Value Grid* $\begin{array}{c\|c\|c} H & T & O \\ \hline 4 & 1 & 2 \\ -2 & 9 & 4 \\ \hline & & \end{array}$ $\qquad$ $\begin{array}{c\|c\|c} H & T & O \\ \hline 3 & 10 & 12 \\ 2 & 9 & 4 \\ \hline 1 & 1 & 8 \end{array}$	
4. Subtraction of Whole Numbers The student should be able to: — subtract numbers with at least six digits in each number	$\begin{array}{r} 412 \\ -\underline{294} \\ 118 \end{array}$ $\quad$ $\begin{array}{r} 1\ 543\ 781 \\ -\underline{\ \ 490\ 394} \\ 1\ 053\ 387 \end{array}$ The process of regrouping, as illustrated at the left, should become a mental process as soon as possible.	
5. Subtraction with Money The student should be able to: a. make change readily for specific amounts of money b. apply the algorithm to solve problems involving money to the limits of #4	NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. Rounding Off for Estimation The student should be able to: — round off numbers to 10's or multiples of 10 to estimate the difference	The estimated answer is a means of checking whether the computed answer is reasonable. Round off to tens: $957 - 263 = 960 - 260 = 700$ Round off to hundreds: $957 - 263 = 1000 - 300 = 700$ NOTE: This should be an oral or mental operation with only the estimated answer recorded.	
7. Checking Subtraction The student should be able to: — use the inverse property to check answers in subtraction	$753 - 85 = 668$ $668 + 85 = 753$ (inverse)	
8. Word Problems The student should be able to: — use number sentences to solve two-step word problems	*Two-Step* 5,000 soldiers were preparing for a parade. During the week before the parade, 120 of them were sent to another camp. On the day of the parade 16 soldiers took ill. How many soldiers marched in the parade? $n = (5000 - 120) - 16$ OR $5000 - (120 + 16) = n$	
EXTENSION:	*Three-Step* Sandra and Maria were planning a party. They went to the store with a $10.00 bill. They bought the following items: 4 large candles at 14¢ each; 15 noise makers at 12¢ each; 15 soft drinks at 22¢ each; and 1 large cake at $1.45. How much change did they get back? $1000 - [(4 \times 14) + (15 \times 12) + (15 \times 22) + (1 \times 145)] = n$	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Multiplication **1. Meaning** **The student should be able to:** **— illustrate concretely or pictorially the meaning of a multiplication number sentence**	The teacher might find it necessary to review the meaning of multiplication by using simple models. a. Addition of equivalent sets  2 + 2 + 2 = 6 3 twos = 6 OR 3 × 2 = 6 b. Arrays  3 twos = 6 OR 3 × 2 = 6 c. Number line  3 twos = 6 OR 3 × 2 = 6	—Dienes blocks —bean sticks —popsicle sticks —tags —Cuisenaire rods —straws —bottle caps —clothespins/hangers —equalizer balance —number line —pegboard —beads —abacus —chips —money —pattern blocks
2. Basic Facts **The student should be able to:** **— recall with proficiency basic multiplication facts up to 100**	Each student should exhibit quick and accurate recall of basic multiplication facts (table). Regular application, number line activities, quizzes, and games will assist in reinforcing these important facts.	

Concepts and Skills are indicated in Bold Face.

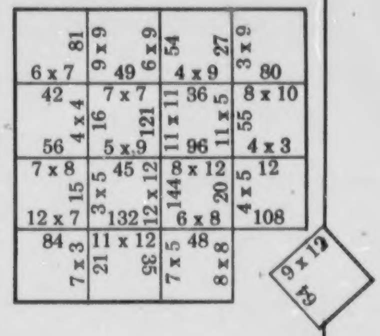
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS

Drill Games and Puzzles

a. *Multo — Puzzle*

— Construct (from bristol board) a puzzle, as in the example, and cut into squares. Have children put pieces together.

—bristol board


6 x 7
81
9 x 9
49
6 x 9
54
4 x 9
27
3 x 9
80
42
4 x 4
56
7 x 7
16
121
5 x 9
11 x 11
36
96
11 x 5
55
8 x 10
4 x 3
7 x 8
15
12 x 7
3 x 5
45
132
12 x 12
8 x 12
144
6 x 8
20
4 x 5
12
108
84
7 x 3
11 x 12
21
35
7 x 5
48
8 x 8
9 x 12
63

b. *Bingo*

— Construct (from bristol board) enough bingo cards for each student in the class. Each card should contain a different set of numerals. The rules may follow popular bingo rules with one major exception: it is not necessary to call a letter with each number. The caller calls 3 × 9, 5 × 10, etc.

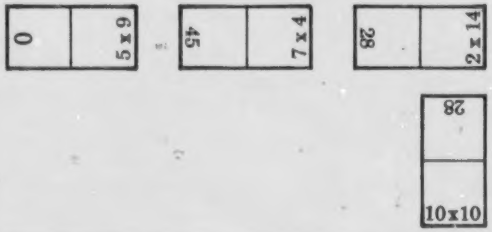
B	I	N	G	O
6	100	27	1	36
49	0	32	10	4
9	5	FREE	64	11
56	25	45	15	14
72	60	96	30	63

Variations are possible:

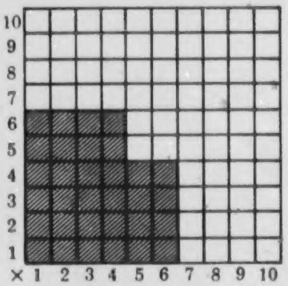
e.g., put 2 factors in each space, e.g., (4 × 7), (7 × 9). Caller calls the products.

c. *Dominoes*

— Construct (from bristol board) 40 dominoes making certain that you have equivalents for each.


0
5 x 9
45
7 x 4
28
2 x 14
28
10x10

Regular rules for dominoes can be adapted for this game.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	d. *Concentration* — This game has been adapted for many mathematical purposes. A set of multiplication fact cards and a set of solutions for the fact cards can be made from bristol board. The cards are placed face down randomly on a table. The object of the game is to have each player match corresponding cards. e. *Pick to Win* — (See the teaching notes on number, beginning of grade 6, in order to find the procedure.) The student with the highest score wins. EXTENSION: Recall with proficiency basic multiplication facts from 100 to 144.	—"Top This" —"Krypto" —"The Winning Touch" —"Heads Up" —"Tuf" —blank playing cards —product grid
3. Multiplying by 10 and Multiples of 10 **The student should be able to:** **— multiply a number by 10 and multiples of 10**	Multiplying by 10's, 100's, and 1000's should be greatly emphasized as this will be a real asset when working with the metric system (decimal). Quick oral work leads to proficiency in estimating. Students should become aware that the multiplication algorithm where 10, 100, 1000, etc., are multipliers, becomes too lengthy and should be a mental process.	
4. Mathematical Properties **The student should be able to:** **a. apply the commutative property to multiplication**	Commutative Property $4 \times 6 = 6 \times 4$  10 9 8 7 6 5 4 3 2 1 × 1 2 3 4 5 6 7 8 9 10	—transparencies —overhead projector —abacus

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. apply the associative property to multiplication	Associative Property $(5 \times 6) \times 7 = 5 \times (6 \times 7)$ $30 \times 7 = 5 \times 42$ $210 = 210$	
c. apply the distributive property to multiplication	Distributive Property $8 \times 420 = 8 \times (400 + 20)$ $= (8 \times 400) + (8 \times 20)$	
d. apply the property of "zero" in multiplication	$8 \times 0 = 0$	
e. apply the property of "one" in multiplication	Identity Number $8 \times 1 = 8$ The property of "one" is applied in finding equivalent fractions, reducing fractions, division of decimals, etc.	
5. Multiplication with Regrouping		
The student should be able to:		
a. regroup using expanded notation	The following are suggested teaching procedures. Not all of these are needed for all students. The students are not expected to do lengthy exercises with all forms but to move as soon as they are ready to the standard algorithm.	
	Expanded Notation 347 = 3 hundreds + 4 tens + 7 ones × 8 × 8 24 hundreds + 32 tens + 56 ones 24 hundreds + 37 tens + 6 ones 27 hundreds + 7 tens + 6 ones 2 thousands + 7 hundreds + 7 tens + 6 ones = 2776 OR 347 = 300 + 40 + 7 × 8 × 8 2400 + 320 + 56 2400 + 370 + 6 2700 + 70 + 6 2000 + 700 + 70 + 6 = 2776	—place value board —Dienes blocks
539		540

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. regroup using place value grid	*Place Value* $\begin{array}{cccc} Th & H & T & O \\ \hline & 3 & 4 & 7 \\ & & \times & 8 \\ \hline & & 5 & 6 \\ & 3 & 2 & 0 \\ 2 & 4 & 0 & 0 \\ \hline 2 & 7 & 7 & 6 \end{array}$ Both processes are integrated into the standard algorithm. $\begin{array}{r} 347 \\ \times\ \ 8 \\ \hline {\scriptstyle 35} \\ 2776 \end{array}$ OR $\begin{array}{r} {\scriptstyle 35} \\ 347 \\ \times\ \ 8 \\ \hline 2776 \end{array}$	—overhead projector —transparency
6. Multiplication Algorithm **The student should be able to:** **— demonstrate the use of the standard algorithm using digits up to a combined total of eight (e.g., 4 digits by 4 digits, 2 digits by 6 digits, etc.)**	Developing the algorithm: a. Stress basic facts. b. Stress estimation activities. c. Stress earlier concepts, i.e., place value, addition. $\begin{array}{rl} 653 & \\ \times\ \ 8 & \\ \cline{1-1} 24 & \text{(ones) } 8 \times 3 \\ 400 & \text{(tens) } 8 \times 50 \\ 4800 & \text{(hundreds) } 8 \times 600 \\ \cline{1-1} 5224 & \end{array}$ The "*standard algorithm*" should be the goal of both teacher and student, as it is the most efficient. $\begin{array}{rl} 653 & \\ \times\ \ 18 & \\ \cline{1-1} 5\ 224 & (8 \times 653) \\ 6\ 530 & (10 \times 653) \\ \cline{1-1} 11\ 754 & \end{array}$ $\left.\begin{array}{r} 653 \\ \times\ \ 18 \\ \hline 5\ 224 \\ 6\ 53 \\ \hline 11\ 754 \end{array}\right\} \longrightarrow$ Students who have no difficulty understanding place value could use this form.	
ENRICHMENT: Multiply using some recognized non-standard algorithms. 541	Non-standard algorithms often provide children with motivating activities, particularly when they are related to history. There are a number of books now available to provide teachers with backgrounds. e.g., lattice multiplication, Napier's Bones, Russian peasant method, doubling method, etc.	542

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
7. Multiplication with Money The student should be able to:		
a. solve money problems using multiplication algorithms	Problems with money should not only be represented by word problems. Money problems should evolve from real-life experiences (shopping at supermarket, classroom financing, etc.), games ("Monopoly", "Stockticker", "Bingo", "Masterpiece", etc.) and projects (unit pricing, stock market, financing a class activity, menus, currency exchange, etc.).	
b. solve "money problems" to the limits expressed in #6 (the Multiplication Algorithm)	If decimals have not been introduced, convert dollars to cents, multiply, and then convert back to dollars. NOTE: An Idea Book on Consumer Education has been placed in all schools by the Department of Education.	
8. Rounding Off for Estimation The student should be able to:		
— round off numbers to 10's or multiples of 10 to estimate the product	Mental calculation should be encouraged on a regular basis.	
9. Checking Multiplication The student should be able to check multiplication by:		
a. comparing the computed answer to the estimated answer	Relate to estimated answer. Think: $\begin{array}{r} 5\,315 \\ \times\quad 64 \\ \hline 21\,260 \\ 318\,900 \\ \hline 340\,160 \end{array} \qquad \begin{array}{r} 5\,000 \\ \times\quad 60 \\ \hline 300\,000 \end{array}$	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. using the commutative principle	Commute factors $\begin{array}{r} 5\,315 \\ \times\quad 64 \\ \hline 340\,160 \end{array} \qquad \begin{array}{r} 64 \\ \times\ 5\,315 \\ \hline 320 \\ 640 \\ 19\,200 \\ 320\,000 \\ \hline 340\,160 \end{array}$	
ENRICHMENT: To check the answer obtained by multiplication, use the "casting out nines" method.	*Casting out Nines* $\begin{array}{rlll} 5\,315 & 5+3+1+5 \rightarrow 14 & 1+4 \rightarrow 5 & \\ \times\quad 64 & 6+4 \longrightarrow 10 & 1+0 \rightarrow 1 & 5\times 1 = \textcircled{5} \\ \hline 340\,160 & \longrightarrow 14 & \longrightarrow \textcircled{5} & \end{array}$ NOTE: This method is not fool-proof, and should not be used exclusively, i.e., one error can eliminate the effect of another.	
10. Word Problems The student should be able to: — use number sentences to solve one- and two-step problems	*Two-Step Problem:* Three boys working at the same rate were unloading two truckloads of boxes on to pallets (small platforms). They placed nine boxes weighing 160 kg each on each pallet. What amount (weight) was placed on each pallet by each boy? $n = (9 \times 160) \div 3$ $= 480$ kg Each boy placed 480 kg on each pallet.	
545		546

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
EXTENSION: To use number sentences to solve word problems of three or more than three steps.	*Three-Step Problem:* The girls had 10 containers of water. Two containers held 500 ml each, 5 containers held 1 litre each, 1 container held 750 ml, and 2 containers held 1.5 litres. How much water would still be needed to fill a large container with a capacity of 10 litres? $10\,000 - [(2 \times 500) + (5 \times 1000) + (1 \times 750) + (2 \times 1500)] = n$ OR $10.00 - [(2 \times 0.5) + (5 \times 1.0) + (1 \times 0.75) + (2 \times 1.5)] = n$ $n = 250$ ml They still require 250 ml to fill the large container.	
E. Division **1. Meaning** The student should be able to:		
a. illustrate concretely or pictorially the meaning of a division number sentence	The meaning of division can be reviewed by having the students find the number of equivalent subsets in a given set and may be expressed as:	—metre stick —currency —blocks —counters —bean sticks —pegboard —balance —games: "Travel on Leftovers", "Top This", "Krypto"
i. as repeated subtraction	Repeated Subtraction $40 \div 8$, $40 - 8 - 8 - 8 - 8 - 8 = 0$, $5 \times 8 = 40$	
ii. as the inverse of multiplication	Inverse of Multiplication $16 \div 2 = 8$ $8 \times 2 = 16$	
iii. as a missing factor	Missing Factor $8 \times \square = 16$	
b. recognize, interpret and apply different division formats	a. $8 \div 4 = 2$ b. $4\overline{)8}$ with 2 above, i.e. $\overset{2}{4\overline{)8}}$ c. $\frac{8}{4} = 2$ d. $\frac{1}{4}$ of $8 = 2$	
c. understand the meaning of divisor, dividend, quotient, remainder, missing factor, divisible	The teacher can *encourage* use of correct terminology by using the correct terms in oral directions, etc.	

547 548

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. Dividing by 10 and Multiples of 10 The student should be able to: — divide where the divisor and the dividend are multiples of 10	e.g., $\begin{array}{r}140\\ 3\,000\overline{)420\,000}\end{array}$ NOTE: The application of the "ones" property is important here. e.g., $420\,000 \div 3\,000 \rightarrow \frac{420\,000}{3\,000} \longrightarrow$ $\frac{420\,000}{3\,000} \div \frac{1\,000}{1\,000} \rightarrow \frac{420\,000 \div 1\,000}{3\,000 \div 1\,000} = \frac{420}{3} = 140$	
3. Mathematical Properties The student should be able to:		
a. apply the property of "zero" to division	$0 \div 9 = 0$ $9 \div 0$ is undefined Some attempt should be made to establish the understanding of division by zero through the use of several examples: $4 \div 4 = 1$ because $1 \times 4 = 4$ $4 \div 2 = 2$ because $2 \times 2 = 4$ $4 \div 1 = 4$ because $4 \times 1 = 4$ $4 \div 0 = 4$ because $4 \times 0 = 4$???? False $4 \div 0 = 0$ because $0 \times 0 = 4$???? False So, division by zero is undefined. But, $0 \div 9 = 0$ because $9 \times 0 = 0$.	
b. apply the property of "one" to division	$9 \div 1 = 9$ $1 \div 9 = \frac{1}{9}$ This also illustrates, of course, that division is *not* commutative.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
c. apply the distributive property in mental arithmetic	*Distributive Property* How many 12's in 72 → $5 \times 12 = 60$ $60 + 12 = 72$ $\therefore 6 \times 12 = 72$	
4. The Division Algorithm **The student should be able to:**		
a. demonstrate the use of the standard algorithm using up to a 3-digit divisor and a 6-digit dividend **i. without remainders** **ii. with remainders**	There are many approaches to division but the "standard algorithm" should be the goal as soon as the students are ready, e.g., 15 350 ÷ 25 = n. a. Repeated Subtraction $\begin{array}{rr} & 15\,350 \\ - & 25 \\ \hline & 15\,325 \\ - & 25 \\ \hline & 15\,300 \\ - & 25 \\ & \downarrow \\ \hline & 0 \end{array}$ b. Scaffold $\begin{array}{r\|r} \multicolumn{1}{r}{614} & \\ 25\overline{)15\,350} & \\ \underline{15\,000} & 600 \\ 350 & \\ \underline{250} & 10 \\ 100 & \\ 100 & 4 \\ \hline 0 & 614 \end{array}$	

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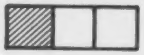
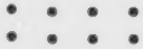
55[illegible]

CONCEPTS, SKILLS AND OBJECTIVES	**TEACHER'S NOTES AND SUGGESTED ACTIVITIES**	**SUGGESTED MATERIALS**
	c. Pyramid $\begin{array}{r} \underline{614} \\ 4 \\ 10 \\ 600 \\ 25\overline{)15\ 350} \\ \underline{15\ 000} \\ 350 \\ \underline{250} \\ 100 \\ \underline{100} \\ 0 \end{array}$ d. Standard Algorithm $\begin{array}{r} 614 \\ 25\overline{)15\ 350} \\ \underline{15\ 0} \\ 35 \\ \underline{25} \\ 100 \\ \underline{100} \\ 0 \end{array}$ NOTE: Decimal remainders should be stressed by the end of the sixth grade, but the teacher may elect to use fractional or whole number notations in the earlier stages. e.g., $\begin{array}{r} 2^{3} \\ 6\overline{)15} \end{array}$ $\begin{array}{r} 2\frac{1}{2} \\ 6\overline{)15} \end{array}$ $\begin{array}{r} 2.5 \\ 6\overline{)15} \end{array}$	
b. use the "short division" algorithm where applicable	As students gain confidence with estimation, division and multiplication facts, they should be encouraged to use the short division algorithm where possible. e.g., $\begin{array}{r} 517 \\ 8\overline{)4136} \end{array}$	
5. Division of Money The student should be able to: — divide an amount of money where the digits do not exceed the limits of #4	Where a remainder occurs in *practical* situations the student should be directed to round off to the nearest cent. Where the situation is statistical in nature, a fractional remainder is acceptable.	

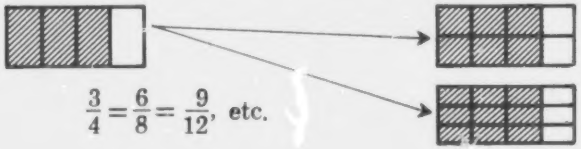
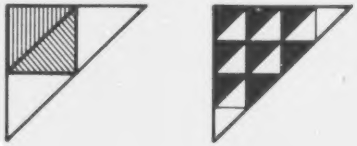
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. **Rounding Off for Estimation** **The student should be able to:** – **round off numbers to 10's or multiples of 10 to estimate the quotient**	The student should always be encouraged to estimate “mentally” where feasible before finding the solution. e.g., $2953 \div 97 = 3000 \div 100 = \boxed{30}$ $2953 \div 47 = 2950 \div 50 = \boxed{59}$	
7. **Checking Division** **The student should be able to:** – **use the inverse operation to check answers in division (NOTE: Where a remainder exists it must be added to the product.)**	$\begin{array}{r} 3\,021\frac{2}{15} \\ 15\overline{)45\,317} \end{array}$ Division $\begin{array}{r} 3\,021 \\ \times\ \ 15 \\ \hline 45\,315 \end{array}$ Multiplication $\begin{array}{r} +\quad 2 \\ \hline 45\,317 \end{array}$ Addition of Remainder	
8. **Average or Arithmetic Mean** **The student should be able to:** – **compute the average of at least three numbers**	Problems related to sports, distance, height, marks, etc., provide interesting activities for students, e.g., find the average height of the 5 boys; Glen — 150 cm, Mark — 136 cm, Dean — 171 cm, Garth — 160 cm, Stanley — 134 cm. $(150 + 136 + 171 + 160 + 134) \div 5 = n$	—graph paper
9. **Word Problems** **The student should be able to:** – **use number sentences to solve one- and two-step word problems**	*Two-Step:* See #8.	

Concepts and Skills are indicated in Bold Face.

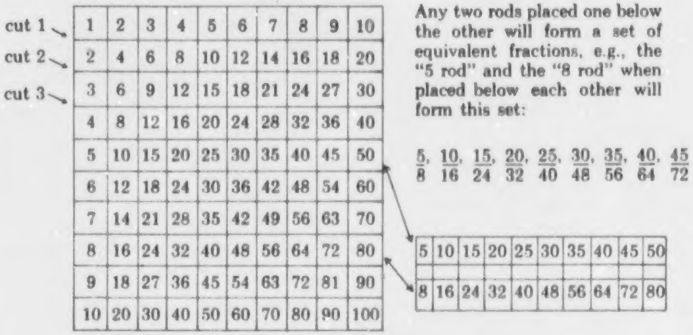
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	EXTENSION: *Three Steps or More* Darcy and his 4 friends decided to buy some material to make some string art pictures. They bought 4 metres of velveteen at \$5.65 a metre, 1 sheet of plywood at \$5.85, 2 boxes of nails at \$1.15 per box, 8 spools of thread at \$1.05 each, and 4 books at \$1.15 each. If they shared the cost evenly how much did each boy have to pay? $[(4 \times 5.65) + (1 \times 5.85) + (2 \times 1.15) + (8 \times 1.05) + (4 \times 1.15)] \div 5 = n$ $\$8.75 = n$	
V. FRACTIONS **A. Meaning** The student should be able to:		
1. illustrate concretely or pictorially the meaning of a fraction	i. Part of a whole  $\frac{1}{3}$ ii. Part of a group  $\frac{2}{8} = \frac{1}{4}$ iii. Division $5\overline{)2} = \frac{2}{5}$ iv. Ratio $5:6 = \frac{5}{6}$ NOTE: It is strongly recommended that the format $\frac{3}{4}$ be used rather than 3/4 as this will facilitate operations and later algebraic concepts.	—pie plates —fraction strips —paper (folding) —string —containers (and liquid) —straws —fraction discs (circles) —number line —geopaper (graph paper) —pegboards
2. understand the meaning of numerator, denominator, proper fraction, improper fraction, mixed number, equivalent fraction	Review the language and illustrate by using models.	
557		558

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Equivalent Fractions **The student should be able to:** **1. illustrate equivalence of fractions using concrete and semi-concrete models**	Where it is efficient one could use concrete aids. However, more time will be spent using pictorial materials.	—transparencies with fraction strips —geoboards —pattern blocks —number line
	Plasticine models Press plasticine into lids or boxes of various shapes (circles, rectangles, triangles). Use pencil lines to divide the models into parts. More lines can show equivalence. $\frac{3}{4}=\frac{6}{8}=\frac{9}{12}$, etc.	—plasticine in lids —fraction bars —Vistrum Fraction Components —Unifix blocks —Cuisenaire rods
	Lines can be removed to show grouping for reducing. The above idea can also be illustrated with fraction bars, Vistrum Fraction Compacts, Unifix blocks, Cuisenaire rods, and paper folding.	—coloured cubes taped together with masking tape
	Area region This can be shown on graph paper or geoboard. This shows $\frac{2}{4}=\frac{8}{16}$	—geopaper —geoboards —fraction strips —paper (folding) —string
	Fraction Chart See grade 4 section.	—straws —number line —Cuisenaire rods —graph paper

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. illustrate equivalent sets of fractions symbolically	*Multiple Rods*	

Cut up a multiplication grid to form multiple rods.



1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

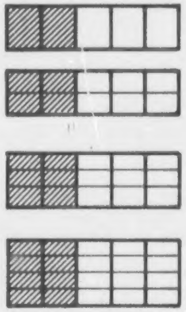
Any two rods placed one below the other will form a set of equivalent fractions, e.g., the "5 rod" and the "8 rod" when placed below each other will form this set:

$\frac{5}{8}, \frac{10}{16}, \frac{15}{24}, \frac{20}{32}, \frac{25}{40}, \frac{30}{48}, \frac{35}{56}, \frac{40}{64}, \frac{45}{72}$

5	10	15	20	25	30	35	40	45	50
8	16	24	32	40	48	56	64	72	80

Renaming "one" as a fraction (form of one)

Sets of equivalent fractions can be formed by multiplying by a form of one, e.g., the set of equivalent fractions for $\frac{2}{5}$ would be formed as follows:



$\frac{2}{5}$

$\frac{2}{5} \times \frac{2}{2} = \frac{4}{10}$

$\frac{2}{5} \times \frac{3}{3} = \frac{6}{15}$

$\frac{2}{5} \times \frac{4}{4} = \frac{8}{20}$

NOTE: Students should discover a rule for finding an equivalent fraction by comparing the fraction names for the models, e.g.,

$$\frac{2}{5} = \frac{4}{10}, \frac{2}{5} = \frac{6}{15}, \text{etc.,}$$

and find the relationship between the two numerators and the two denominators.

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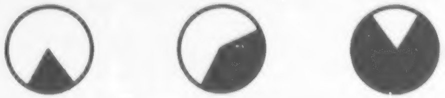
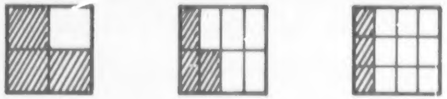
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Crazy Fractions (card games) Players — 3 or 4; 72 cards. Cards are marked with the following sets of fractions: halves, thirds, fourths, fifths, sixths, eighths, tenths. (For halves there will be two cards — $\frac{1}{2}$, $\frac{2}{2}$; for fifths there will be five cards — $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$, $\frac{5}{5}$, etc.) There are also four whole number cards: one, two, three, and four. The dealer gives each player seven cards. One card is turned face up, with the remainder of the deck face down on the centre of the table. The player to the left of the dealer discards a card of the same suit (denominator), or a card of equivalent value to the card face up on the table, or a whole number card. Whole number cards are "wild" cards since they can be renamed with any denominator. During his/her turn, the player may discard or draw a card from the deck if he/she has no play. The object of the game is to get rid of all cards in the player's hand. The player receives 25 points for getting rid of all his/her cards, plus a total of all cards remaining in the hands of all other players — 1 point for each fraction less than $\frac{1}{2}$, 2 points for each fraction greater than or equal to $\frac{1}{2}$, 3 points for each whole number. Number of points necessary to win a game should be agreed upon before play begins. Fifty or one hundred points work well for most classes.	—blank cards (or manilla tag)
3. reduce a fraction to its lowest term	Use visual aids to create understanding. Stress reducing by dividing by a form of one. e.g., $\frac{10}{15} \div \frac{5}{5} \longrightarrow \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	Reference to the greatest common factor should also be made to shorten the work. e.g., $\frac{16}{24} \div \frac{2}{2} = \frac{8}{12} \div \frac{2}{2} = \frac{4}{6} \div \frac{2}{2} = \frac{2}{3}$ However, the factors of 16 are 1, 16, 2, 8, 4 or 1, 2, 4, ⑧ 16 and the factors of 24 are 1, 24, 2, 12, 3, 8, 4, 6 or 1, 2, 3, 4, 6, ⑧ 12, 24. Thus the greatest common factor is 8. So $\frac{16}{24} \div \frac{8}{8} = \frac{2}{3}$	
4. rename an improper fraction as a mixed number or whole number and vice versa	Understanding of regrouping or of "borrowing" and "carrying" is necessary and can be maintained by practice. e.g., $\begin{array}{r} 6\frac{1}{4} \\ -2\frac{3}{4} \\ \hline \end{array} = 5 + 1 + \frac{1}{4} = \begin{array}{r} 5\frac{5}{4} \\ -2\frac{3}{4} \\ \hline 3\frac{2}{4} \end{array} = 3\frac{1}{2}$ e.g., $\begin{array}{r} 2\frac{1}{3} \\ +1\frac{2}{3} \\ \hline 3\frac{3}{3} \end{array} = 4$	
C. Comparing Fractions The student should be able to: 1. compare fractions where the denominator remains the same and the numerator changes and vice versa	Diagrams could be drawn by the student to compare fractions and draw conclusions. e.g., $\frac{1}{5}, \frac{2}{5}, \frac{4}{5}$  e.g., $\frac{3}{4}, \frac{3}{8}, \frac{3}{12}$ 	
2. compare fractions with unlike numerators and denominators where the lowest common denominator (L.C.D.): a. is one of the given denominators	e.g., $\frac{5}{12}, \frac{3}{4}$ L.C.D. is 12	—transparencies with overlays —equivalent fraction strips —equivalent fraction chart

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. is the product of two of the denominators	e.g., $\frac{2}{5}, \frac{5}{8}, \frac{4}{5}$ L.C.D. is 5×8 or 40.	
c. is a multiple less than the product of two of the denominators	e.g., $\frac{5}{6}, \frac{7}{9}$ L.C.D. is 18, which is less than 6×9 or 54.	

A number of methods can be used to find the lowest common denominator (L.C.D.) for comparing fractions.

In essence, finding common denominators amounts to finding equivalent fractions using the lowest common multiple of the denominators.

Multiple Rods could be used. List a number of multiples of each denominator and select the lowest common multiple.

e.g., $\frac{2}{③}$ — 3, 6, 9, 12, $\underline{15}$, 18 . . .

$\frac{3}{⑤}$ — 5, 10, $\underline{15}$, 20, 25 . . .

A simplified method of the above would be to find multiples of the largest denominator and note which is also a multiple of the other denominators.

e.g., Compare — $\frac{5}{6}, \frac{7}{9}, \frac{11}{12}$

The multiples of the largest denominator, 12 are 12, 24, 36 . . . 36 is also a multiple of 9 and 6. Thus the L.C.D. is 36.

Here "multiplying by a fractional form of one" to find equivalent fractions is useful:

$\frac{5}{6} \times \frac{\square}{\square} = \frac{}{36}$; so $\frac{5}{6} \times \boxed{\frac{6}{6}} = \frac{30}{36}$

$\frac{7}{9} \times \frac{\square}{\square} = \frac{}{36}$; so $\frac{7}{9} \times \boxed{\frac{4}{4}} = \frac{28}{36}$

$\frac{11}{12} \times \frac{\square}{\square} = \frac{}{36}$; so $\frac{11}{12} \times \boxed{\frac{3}{3}} = \frac{33}{36}$

Order the answer, e.g., $\frac{28}{36} < \frac{30}{36} < \frac{33}{36}$

Now the fractions can be compared as follows:
$\frac{7}{9} < \frac{5}{6} < \frac{11}{12}$

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. compare fractions by arranging them in order from smallest to largest and vice versa	See grade 5 section.	
D. Fractions in Division		
The student should be able to:		
1. express division of two whole numbers as a fraction	e.g., $10 \div 2 = 5 \rightarrow \frac{10}{2} = 5$ $4 \div 5 = \frac{4}{5}$	
2. write a remainder in division as a fraction (where applicable)	e.g., $7 \div 3 = 2\frac{1}{3}$ The problem will indicate whether or not it is applicable to write the remainder as a fraction. e.g., $2\frac{1}{3}$ pies, but *not* $2\frac{1}{3}$ cars	
E. Addition		
The student should be able to:		
1. add proper fractions with like or unlike denominators where the sum is less than, equal to, or greater than one	Concrete material (fraction strips, pie plates) may be used for review activities.	

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
a. without regrouping	*Without regrouping* $\frac{1}{6}+\frac{4}{6}=\frac{5}{6}$ $\frac{1}{2}+\frac{1}{3}=\frac{3}{6}+\frac{2}{6}=\frac{5}{6}$ $\left\{\frac{1}{2}\times\frac{3}{3}=\frac{3}{6};\ \frac{1}{3}\times\frac{2}{2}=\frac{2}{6}\right\}$	—paper folding or cutting —fraction strips —pie plates —number line
b. with regrouping	*With regrouping* $\frac{4}{5}+\frac{4}{5}=\frac{8}{5}=1\frac{3}{5}$ $\frac{3}{4}+\frac{2}{3}=\frac{9}{12}+\frac{8}{12}=\frac{17}{12}=1\frac{5}{12}$ $\left\{\frac{3}{4}\times\frac{3}{3}=\frac{9}{12};\ \frac{2}{3}\times\frac{4}{4}=\frac{8}{12}\right\}$ The above is a good example of the application of the identity number in multiplication (one).	
2. add mixed numbers with like or unlike denominators		
a. without regrouping	*Without regrouping* $2\frac{1}{3}+1\frac{1}{2}=n\longrightarrow 2\frac{2}{6}+1\frac{3}{6}=3\frac{5}{6}$ $\left\{\frac{1}{3}\times\frac{2}{2}=\frac{2}{6};\ \frac{1}{2}\times\frac{3}{3}=\frac{3}{6}\right\}$	
b. with regrouping 571	*With regrouping* $1\frac{2}{5}+2\frac{3}{4}\longrightarrow 1\frac{8}{20}+2\frac{15}{20}=3\frac{23}{20}=4\frac{3}{20}$ $\left\{\frac{2}{5}\times\frac{4}{4}=\frac{8}{20};\ \frac{3}{4}\times\frac{5}{5}=\frac{15}{20}\right\}$	572

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. **add proper fractions and/or mixed numbers up to four addends**		
4. **add fractions using vertical and horizontal formats**		
5. **apply the properties of whole numbers (commutative, associative, zero) to addition of fractions**	*Commutative* $\frac{1}{2} + \frac{1}{4} = \frac{1}{4} + \frac{1}{2}$ *Associative* $\frac{2}{3} + \left(\frac{5}{6} + \frac{1}{2}\right) =$ $\left(\frac{2}{3} + \frac{5}{6}\right) + \frac{1}{2}$ *Zero* $0 + \frac{3}{4} = \frac{3}{4}$ $\frac{1}{2} + 0 = \frac{1}{2}$	
6. **use number sentences to solve one- and two-step word problems**	See section on problem solving. e.g., Gerald spent $\frac{1}{2}$ hour on his homework on Monday, $\frac{3}{4}$ hour on Tuesday, $\frac{1}{2}$ hour on Wednesday, $\frac{1}{4}$ hour on Thursday and $\frac{1}{5}$ hour on Friday. How much time did he spend during the school week on his homework? $\frac{1}{2} + \frac{3}{4} + \frac{1}{2} + \frac{1}{4} + \frac{1}{5} = n$ $\qquad 2\frac{1}{5}\text{ hour} = n$	
F. Subtraction The student should be able to:		
1. **subtract proper fractions with like or unlike denominators**	a. *Like denominators* $\frac{4}{5} - \frac{1}{5} = \frac{3}{5}$ b. *Unlike denominators* $\frac{4}{5} - \frac{1}{2} = n \longleftrightarrow \frac{8}{10} - \frac{5}{10} = \frac{3}{10}$ $\left\{ \frac{4}{5} \times \frac{2}{2} = \frac{8}{10} ; \frac{1}{2} \times \frac{5}{5} = \frac{5}{10} \right\}$	
573		574

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
2. subtract proper fractions and mixed numbers from whole numbers	$8 - 4\frac{1}{2} = n \longrightarrow (7 + 1) - 4\frac{1}{2} = n \longrightarrow 7\frac{2}{2} - 4\frac{1}{2} = 3\frac{1}{2}$ It is important that the students understand how to express "one" as a fraction.	
3. subtract mixed numbers and/or proper fractions from mixed numbers with like or unlike denominators		
a. without regrouping	e.g., *Like denominator without regrouping* $4\frac{4}{5} - 1\frac{2}{5} = n,\ n = 3\frac{2}{5}$	
b. with regrouping	e.g., *Like denominator with regrouping* $6\frac{1}{5} - 2\frac{4}{5} = n$ $5\frac{6}{5} - 2\frac{4}{5} = 3\frac{2}{5}$ e.g., *Unlike denominator with regrouping* $3\frac{1}{4} - 1\frac{2}{3} = n \longleftrightarrow 3\frac{3}{12} - 1\frac{8}{12} = n \longleftrightarrow 2\frac{15}{12} - 1\frac{8}{12} = n \longleftrightarrow n = 1\frac{7}{12}$ $\left\{\frac{1}{4} \times \frac{3}{3} = \frac{3}{12};\ \frac{2}{3} \times \frac{4}{4} = \frac{8}{12}\right\}$ $\begin{array}{r} 3\frac{1}{4} \\ -1\frac{2}{3} \\ \hline \end{array} \longrightarrow \begin{array}{r} 3\frac{3}{12} \\ -1\frac{8}{12} \\ \hline \end{array} \rightarrow \begin{array}{r} 2 + 1 + \frac{3}{12} \\ - \quad 1\frac{8}{12} \\ \hline \end{array} \longrightarrow \begin{array}{r} 2\frac{15}{12} \\ -1\frac{8}{12} \\ \hline 1\frac{7}{12} \end{array}$	
4. subtract fractions using vertical and horizontal formats		
5. use number sentences to solve one- and two-step word problems	See section on problem solving.	

CONCEPTS, SKILLS AND OBJECTIVES

G. Multiplication

The student should be able to:

1. multiply a fraction by a whole number and vice versa
2. multiply a whole number by a mixed number and vice versa
3. use number sentences to solve one- and two-step word problems

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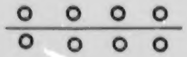
TEACHER'S NOTES AND SUGGESTED ACTIVITIES

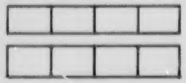
Concrete or pictorial illustrations (like the following) should be used, since this is a new concept.

It might be advisable to construct and discuss the following:

$$3 \times 8 = 24$$
$$2 \times 8 = 16$$
$$1 \times 8 = 8$$
$$\frac{1}{2} \times 8 = 4$$
$$\frac{1}{4} \times 8 = 2$$

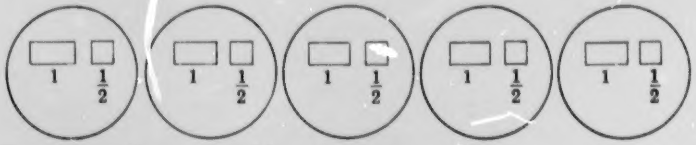
e.g., a. $\frac{1}{2}$ of $8 = n$ $\qquad \frac{1}{2} \times 8 = 4$





b. $8 \times \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{8}{2} = 4$

e.g., $5 \times 1\frac{1}{2} = n \quad (5 \times 1) + (5 \times \frac{1}{2}) = 5 + 2\frac{1}{2} = 7\frac{1}{2}$



See the section on problem solving.

EXTENSION:
1. multiply a fraction by a fraction
2. multiply a mixed number by a mixed number
3. reduce fractions before multiplying
4. divide using fractions

SUGGESTED MATERIALS

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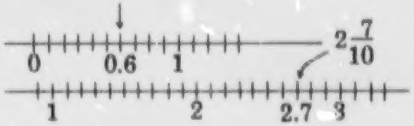
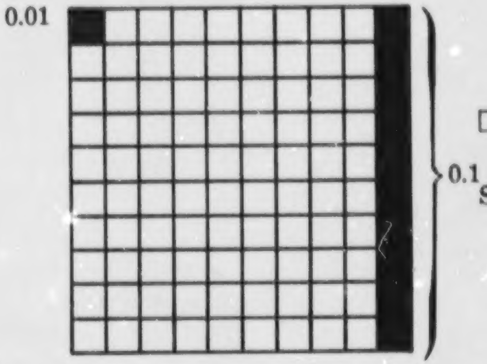
Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
VI. DECIMALS **A. Meaning** The student should be able to understand decimals: **1. as a form of representing fractional numbers in base ten**	i. number line  ii. square paper grid  $\square = \frac{1}{100} = 0.01$ Strip $= \frac{1}{10} = \frac{10}{100} = 0.1 = 0.10$	—hundred grid —geoboard —Dienes blocks —place value grid
2. as an extension of the place value grid		—place value board

	TEN THOUSANDTHS	THOUSANDTHS	HUNDREDS	TENS	ONES	TENTHS	HUNDREDTHS	THOUSANDTHS
	10 000	1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
e.g.,	1	1	1	1	1	.1	1	1
						.1		
						.0	1	
						.0	0	1

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>3. by relating our numeration system to our money system, and the SI metric system</td><td><table><tr><td>ones</td><td>tenths</td><td>hundredths</td><td>thousandths</td></tr><tr><td>1.0</td><td>0.1</td><td>0.01</td><td>0.001</td></tr><tr><td>dollar</td><td>dime</td><td>cent</td><td>mill</td></tr><tr><td>SI</td><td>deci</td><td>centi</td><td>milli</td></tr></table>
NOTE: Metric unit could be m, ℓ or g.</td><td></td></tr>
<tr><td>B. Place Value
The student should be able to:</td><td></td><td></td></tr>
<tr><td>1. read and write decimal numbers up to 3 places</td><td>e.g., 24.705 may be read as:
i. 24 point seven zero five <i>or</i>
ii. 24 decimal seven zero five <i>or</i>
iii. 24 and seven hundred five thousandths</td><td></td></tr>
<tr><td>2. give the value of any digit in a decimal number</td><td>e.g., 4.672 → 4 ones, 6 tenths, 7 hundredths, 2 thousandths</td><td></td></tr>
<tr><td>C. Expanded Notation
The student should be able to:</td><td></td><td></td></tr>
<tr><td>— write decimals up to 3 places in expanded notation</td><td>e.g., 42.605 = 4 tens + 2 ones + 6 tenths + 0 hundredths + 5 thousandths
OR
$42.605 = 40 + 2 + \frac{6}{10} + \frac{0}{100} + \frac{5}{1000}$
OR
$42.605 = 40 + \frac{26}{10} + \frac{5}{1000}$</td><td>—same materials as for whole numbers</td></tr>
<tr><td>581</td><td></td><td>582</td></tr>
</table>

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
D. Renaming Decimals The student should be able to:		
1. express decimals up to 3 places in fractional notation in reduced form and vice versa	e.g., expressing a decimal as a fraction $0.25 = \frac{25}{100} = \frac{1}{4}$ e.g., expressing a fraction as a decimal i. using the "ones" principle $\frac{3}{4} \times \frac{}{} = \frac{\quad}{100}$; so $\frac{3}{4} \times \frac{25}{25} = \frac{3 \times 25}{4 \times 25} = \frac{75}{100} = 0.75$ ii. using the division method $\frac{3}{5} = \begin{array}{r} 0.6 \\ 5\overline{)3.0} \end{array}$	
	Roll and Match (Dice Game) Six dice are marked as follows:	—blank dice or cubes
	$\left\{\frac{1}{2}, \frac{2}{6}, \frac{4}{20}, .4, \frac{2}{12}, \frac{3}{2}\right\}$ $\left\{\frac{2}{3}, .25, \frac{75}{100}, \frac{5}{6}, \frac{13}{5}, \frac{6}{15}\right\}$ $\left\{.5, \frac{6}{9}, \frac{9}{12}, \frac{4}{10}, \frac{15}{18}, \frac{7}{4}\right\}$ $\left\{\frac{1}{4}, \frac{1}{5}, \frac{4}{5}, 1.75, 2\frac{2}{3}, \frac{3}{9}\right\}$ $\left\{\frac{1}{3}, \frac{3}{4}, .8, \frac{9}{15}, 1.5, \frac{1}{6}\right\}$ $\left\{\frac{2}{4}, \frac{2}{5}, .2, \frac{8}{10}, 1\frac{1}{2}, \frac{8}{3}\right\}$	
	All six dice are rolled and the player scores one point for each correct match.	
2. express a decimal as a percent	The hundred grid is most useful for this purpose.	—overhead projector —transparencies
E. Repeating Decimal Notation	IT IS SUGGESTED THAT REPEATING DECIMALS *NOT* BE TAUGHT, AND THAT TEACHERS ONLY ANSWER QUESTIONS ASKED BY STUDENTS.	

5 3

5 4

Concepts and Skills are indicated in Bold Face.

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<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>

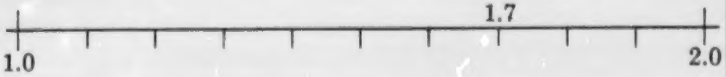
F. Rounding Off

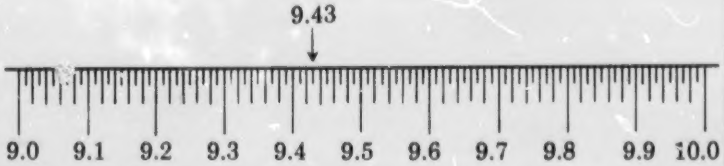
The student should be able to:

— round off decimals to wholes, tenths, or hundredths

</td><td>

This concept should be treated in the same manner as rounding off a whole number.





1.7 is rounded to 2.0
9.43 is rounded to 9.4
Similarly, 6.568 is rounded to 6.57

</td><td>

—number line

</td></tr>
<tr><td>

G. Addition and Subtraction

The student should be able to add or subtract decimals:

1. using tenths, hundredths, or thousandths
2. using a combination of tenths, hundredths and thousandths
3. using vertical and horizontal notation
4. using number sentences to solve one- and two-step word problems

</td><td>

Review place value and addition of whole numbers. Extend the place value chart to include fractional parts (i.e., decimals). Use the grid for introducing addition and subtraction.

</td><td></td></tr>
</table>

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
H. Multiplication The student should be able to: – multiply a decimal by a whole number and vice versa	Estimating the product is very important. e.g., 5 × 1.52 1.52 is between the whole numbers 1 and 2. Thus the product must be between 5 (5 × 1) and 10 (5 × 2) and closer to 10 since 1.52 rounds off to 2. The operation of multiplying with decimals and whole numbers should be compared for similarities. $\begin{array}{r} 152 \\ \times\ \underline{5} \\ 760 \end{array} \qquad \begin{array}{r} 1.52 \\ \times\ \underline{5} \\ 7.60 \end{array}$ Initial experiences with Dienes blocks and grid paper (or geoboard) will provide some basis for understanding.	—graph paper —geoboard
I. Division The student should be able to: – divide with up to a 3-digit decimal divisor by converting to whole numbers	NOTE: A review of multiplication of decimals and whole numbers, and division of whole numbers should precede development of the algorithm. e.g., $\begin{array}{r} 22.63 \\ 21\overline{)475.23} \\ \underline{42} \\ 55 \\ \underline{42} \\ 13\,2 \\ \underline{12\,6} \\ 63 \\ \underline{63} \end{array}$	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	The property of one may be used as follows: $.14\overline{)6.394}$ $\downarrow$ $\frac{6.394}{.14} \times 1$ $\downarrow$ $\frac{6.394}{.14} \times \frac{100}{100} \rightarrow \frac{639.4}{14}$ $\downarrow$ $14\overline{)639.4}$ $\downarrow$ $14\overline{)639.4000}$ etc. NOTE: A review of multiplication of decimals and whole numbers, and division of whole numbers should precede development of the algorithm.	
J. Word Problems The student should be able to: — use number sentences to solve one- and two-step word problems	See the section on problem solving. EXTENSION: Use number sentences to solve more than two-step word problems.	
VII. RATIOS AND PROPORTION **A. Ratio** The student should be able to: — recognize, interpret and use different ratio formats	*Formats* a. 2 to 5 b. 2:5 c. $\frac{2}{5}$ A ratio (not to be confused with rate) is the quotient of two quantities stated as a fraction without a unit of measure. A ratio may also be represented by any fractional equivalent. e.g., if three of five people wear eyeglasses they may be expressed as the ratio $\frac{3}{5}$ or 3:5.	

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CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Proportion (Equal Ratios)		
The student should be able to: **— use a proportion to solve ratio problems**	Stress recognition of proportion as a comparison between two ratios and represented by equivalent fractions. ENRICHMENT: Ratio and proportion formats provide a useful technique for problem solving. If the ratio of men to women is 4:5 and there are 20 women, how many men are there? For example: $\frac{4}{5} = \frac{n}{20}$ Using the section on equivalent fractions (grade 4) to find "n" in $\frac{4}{5} = \frac{n}{20}$, ask the student, "How many 5's are in 20?" (Answer is 4 — this 4 will be the denominator.) "What number will be put in the numerator to make the fraction equal one?" $\frac{4}{5} \times \frac{4}{4} = \frac{n}{20}$ Expressing "n" as a missing factor, the student will use the inverse relationship to find that n = 16.	
VIII. PERCENT **The student should be able to:**		
1. identify a percent as a different way of expressing:	Percent is a way of expressing comparisons. Practical applications are numerous within the classroom. Good graphing and problem-solving situations may be initiated through this concept. The "hundred chart" is most useful in relating percent to "hundredness". NOTE: The concept of percent could be integrated with the concept of decimals.	—hundred grid
a. a fraction with a denominator of 100	Study of sales tax (5%); application of sales tax in a problem-solving situation. Simple calculations might be used such as 5% of a $1.00 purchase or 5% of a $100.00 purchase.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. a two-place decimal **c. a ratio**	For example, 85% suggests that 85 questions were correct out of a total of 100, or that, out of a possible 100 points, 85 were scored.	
2. rename a percent as:		
a. a fraction and vice versa	$45\% = \frac{45}{100} = \frac{9}{20}$ $\frac{1}{4} = \frac{25}{100} = 25\%$	
b. a decimal and vice versa	$0.3 = 0.30 = 30\%$ $50\% = 0.50 = 0.5$	
IX. MEASUREMENT **Readiness for Metric Measure**	Estimation plays an important role in the development of measurement. Always encourage the student to estimate the answer before calculating the exact answer. Pupils learn to measure first with non-standard units and then with metric units — centimetres, metres, litres, kilograms, etc. Children should learn to use these terms as much as possible. They should be involved in vocabulary related to their social experiences, e.g., I weigh 40 kilograms. (In everyday life, mass and weight are often used interchangeably.) *Do not convert* from the present Imperial system — use the new unit for measuring. However, there are times when it might be helpful to compare the new unit to the old unit, e.g., a litre is a little smaller than a quart. Measurement should not be treated as an isolated unit of learning, but should be meaningfully integrated throughout the year. The textbook you are using may not have a full metric program and you might need supplementary material or you might change non-metric problems to metric problems. Most of the activities should be done in small groups so that each pupil may participate.	—ropes —sticks —rods —blocks

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
A. Linear Measurement **The student should be able to:**		
1. recall the concepts of kilometre, metre, decimetre, centimetre, and millimetre through measurement activities	Measuring experiences will provide a good review of linear measure.	—30 cm or 20 cm rulers —metre sticks —metric tape measures —metric trundle wheel —calipers —micrometers —string —geostrip —number line
2. express linear relationships using multiples and submultiples of the metre (i.e., prefixes)	After doing some measuring activities which show the relationship between the various linear units, e.g., 50 cm = 0.5 m, the following metric grid could be constructed to simplify the understanding of the metric system.	

kilo	hecto	deca		deci	centi	milli
km	hm	dam	m	dm	cm	mm
1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
5	0	0	0			
5	0	0	0	0	0	

i.e., 5 km = 5000 m
= 500 000 cm

see grid above

NOTE: The underlined measures are those most commonly used in SI measurement.

3. relate the metric system to the decimal numeration system

The above grid has the same structure as a base ten place value grid.

4. use operations (+, −, ×, ÷) on linear measures

$$\begin{array}{r} 3\text{ m}\ \ 92\text{ cm}\ \ 7\text{ mm} \\ +\ \underline{6\text{ m}\ \ 85\text{ cm}\ \ 9\text{ mm}} \end{array} \longrightarrow \begin{array}{r} 3\text{ m}\ \ 92.7\text{ cm} \\ +\ \underline{6\text{ m}\ \ 85.9\text{ cm}} \end{array} \longrightarrow \begin{array}{r} 3.927\text{ m} \\ +\ \underline{6.859\text{ m}} \\ 10.786\text{ m} \end{array}$$

5[illegible]5

5[illegible]6

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
	NOTE: 1. You could convert to mm or cm, as well as metres, and add and compare answers. 2. 3 m and 5 cm and 1 mm to be written as 3.051 m. 3. Do not compute with mixed units but change all measures to the same units before computing.	
5. **select the appropriate unit for estimating and measuring length**	Students should learn to select the appropriate unit for measuring length, e.g., measure the length of the gym in metres, not km or cm or mm.	
6. **use km/h (kilometres per hour) to express a rate of travel**	This will become more meaningful when the highway signs use kilometres for measuring distances and speed limits are marked in kilometres per hour.	
7. **estimate and measure the perimeter of various shapes in the appropriate unit (m, cm, mm)**	The perimeter of regular and irregular shapes could be found using transparent cm^2 grids. Finding shortcuts in calculating the perimeter of regular quadrilaterals should lead to establishing the formula, i.e., $p = 2L + 2W$ or $2(L + W)$.	
B. Area The student should be able to:		
1. **recall the concept of cm^2 and m^2 through construction and measurement activities**	Review the "covering" concept of area. Also see grade 5 section.	—see section A on linear measurement —centimetre graph paper —geopaper —metric geoboards —geoboard —pattern blocks —floor coverings —wall coverings
2. **recall the use of km^2 to measure large areas shown as scale drawings**		
3. **estimate and calculate the area of a rectangle and a square, using the appropriate unit**	Discover the formula by investigating the number of square units in a row and the number of rows of square units. $A = L \times W$	
EXTENSION: Use the hectare as a unit of land measure.	$100 \times 100\ m^2 = 10\ 000\ m^2 = 1$ hectare	

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Volume		
The student should be able to:		
1. recall the concept of cm³, dm³, and m³ with construction and measurement activities	Review the "filling" concept of volume. Also see grade 5 section.	
2. estimate and measure volume, selecting the appropriate unit	Discover the formula: V = L × W × H	
3. explore the relationship between volume and capacity	Volume is best represented by cubic (solid) blocks, while "pouring" activities are most suitable for capacity. Encourage the discovery that: 1 dm³ of water = 1 litre 1 m³ of water = 1000 litres = 1 kl	—centimetre cubes —cubic containers
D. Capacity		
The student should be able to:		
1. express millilitres (ml) as litres (ℓ) and vice versa, using decimal notation	Construct a capacity grid. Note its relation to the linear grid. e.g.,	—graduated metric beakers —cylinders and cubic containers —a variety of ungraduated containers —syringes —eyedroppers —pails —displacement container

ℓ	dl	cl	ml
1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
4	5	3	2

1 ℓ = 1000 ml

$\frac{1}{10}$ ℓ = 100 ml

.4532 ml = 4ℓ 532 ml
= 4.532 ℓ

2. estimate and measure capacity, selecting the appropriate unit	NOTE: The underlined units are those most commonly used in SI measurement.	
3. use operations on capacity measure		
4. explore the relationship between volume and capacity	1 cm³ of water = 1 ml	

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Concepts and Skills are indicated in Bold Face.

<table>
<tr><th>CONCEPTS, SKILLS AND OBJECTIVES</th><th>TEACHER'S NOTES AND SUGGESTED ACTIVITIES</th><th>SUGGESTED MATERIALS</th></tr>
<tr><td>E. Mass
The student should be able to:</td><td></td><td></td></tr>
<tr><td>1. express grams as kilograms and vice versa, using decimal notation</td><td>Construct a mass grid. Note its relation to the linear grid.
e.g.,
<table>
<tr><th><u>kg</u></th><th>hg</th><th>dag</th><th><u>g</u></th><th>dg</th><th>cg</th><th><u>mg</u></th><th></th></tr>
<tr><td>1000</td><td>100</td><td>10</td><td>1</td><td>$\frac{1}{10}$</td><td>$\frac{1}{100}$</td><td>$\frac{1}{1000}$</td><td>1 kg = 1000 g</td></tr>
<tr><td>6</td><td>7</td><td>9</td><td>8.</td><td>7</td><td>2</td><td>4</td><td></td></tr>
</table>
NOTE: The underlined units are those most commonly used.</td><td></td></tr>
<tr><td>2. estimate and measure mass, selecting the appropriate unit</td><td>Investigate food products which are packaged in kilograms or portions thereof.</td><td>—metric bathroom scales
—balance scales</td></tr>
<tr><td>3. use operations on mass measures</td><td></td><td></td></tr>
<tr><td>4. use the metric tonne (t) to express large quantities of mass</td><td>Refer to wheat sales of other countries and to ship capacities. (1 metric tonne = 1000 kg)</td><td></td></tr>
<tr><td>5. explore the relationship between volume, capacity, and mass</td><td>1 cm^3 of water = 1 ml and has a mass of 1 g
1 dm^3 water = 1 ℓ and has a mass of 1 kg
1 m^3 water = 1 kl and has a mass of 1 t</td><td>--displacement container
—compression scales
—spring scales
—metric masses</td></tr>
<tr><td>F. Money
The student should be able to:</td><td></td><td></td></tr>
<tr><td>— solve money problems in addition, subtraction, multiplication, and division</td><td>See grade 4 section on money.</td><td></td></tr>
<tr><td>601</td><td></td><td>602</td></tr>
</table>

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
G. Time		
1. Estimate and Measure		
The student should be able to:		
a. estimate the time needed for doing a certain task b. compare the estimated time for doing a certain task to the known time required for another task	Time lengths of various events at a school track meet could be used as an introduction. These known time lengths could then be used as a comparison to estimate the time required for other activities, e.g., compare the known record time for the 100 metre dash to reciting the 8 times table.	—stop watch —pendulum —metronome —hourglass
c. measure the time needed for doing a certain task	The student could use the stop watch to measure activities such as dashes, speed tests, etc. Longer time periods could be made more meaningful by placing historic events, births and deaths, etc., on a time line. Graphing life spans of important people or ancestors would also add interest.	
2. Units of Time		
The student should be able to:		
a. recall and maintain the relationships among second, minute, hour, day, week, month, year, decade, century		—clock faces —calendars —time lines
b. record the date in SI format	e.g., 1977 (year) 11 (month) 17 (day) (hour if applicable)	
3. Telling Time		
The student should be able to:		
a. read the time on:		
i. a 24-hour clock	e.g., 4:25 a.m. as 04 25 and 4:25 p.m. as 16 25	
ii. a digital clock		

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Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
b. regroup minutes to hours and vice versa to add and subtract units of time	4 hr and 25 min — 2 hr and 35 min → 3 hr and 85 min — 2 hr and 35 min 1 hr and 50 min	
H. Temperature		
The student should be able to:		
— read the Celsius thermometer above and below zero	Daily or hourly outdoor temperatures could be recorded and graphed. Other science-related activities involving water, ice, body temperatures, etc., could be used.	—Celsius thermometer
X. GEOMETRY		
A. Solid and Plane Shapes		
The student should be able to:		
— recall most of the basic concepts developed in earlier grades (K-5)	The student should develop a table relating the number of faces, angles, and edges of various 3-D and 2-D shapes.	—solid models —geoblocks —plane models
B. Curves and Lines		
The student should be able to:		
— identify and distinguish between curves and straight lines	Prepare activities where children can seek out curves and straight lines in objects and materials around them.	—pegboards —toothpicks —curve stitching
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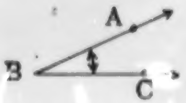
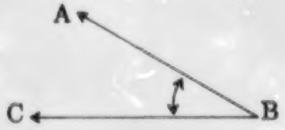
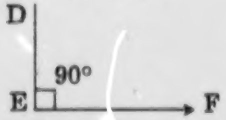
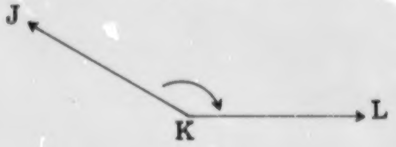
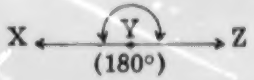
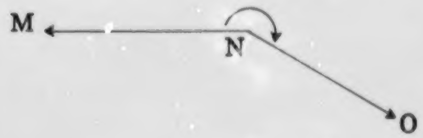
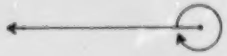
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
C. Angles **The student should be able to:**		
1. name the parts and label an angle	 arms AB, BC vertex B ∠ABC	—paper folding —geostrips —meccano parts —blackboard compass —large clock dial
2. measure angles with a protractor	The circular protractor has one advantage in that the student can see the complete scale. Relate the protractor to the circle. It is essential that the children get sufficient practice with the protractor in order to develop an understanding of angle measurement.	—protractor
3. classify angles according to their size (degrees)	*Acute Angle* Measure of ∠ ABC < 90°  *Right Angle* Measure of ∠ DEF = 90°  *Obtuse Angle* Measure of ∠ JKL > 90° and < 180°  *Straight Angle* Measure of ∠ XYZ = 180°  *Reflex Angle* Measure of ∠ MNO > 180° and < 360°  *Complete Revolution* 	—protractor —toothpicks —geostrips —rulers
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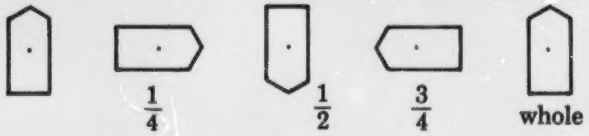
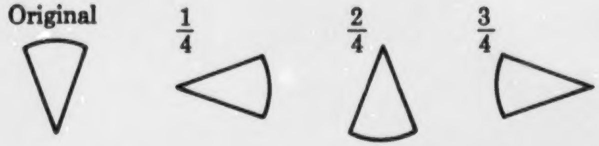
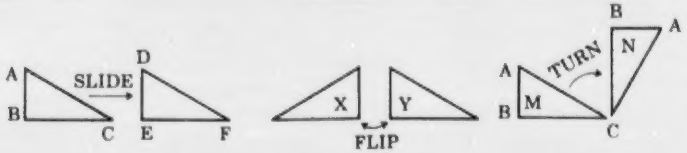
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
4. **illustrate "turning" of shapes through $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$ and whole turns**	e.g.,  A shape may be turned around an internal or an external point. 	—protractor —environmental objects
5. **identify the fraction of a turn through which a shape(s) has been turned**	Rotation should be approximated only in a clockwise or in a counter-clockwise direction. Have pupils turn a football, a pencil, a rock (not completely rounded), and other similar objects and identify the fraction of a turn.	
D. Triangles The student should be able to: — **classify triangles according to the number of equal (congruent) sides:** — **scalene** — **isosceles** — **equilateral**	Have students measure triangles for congruent sides. What conclusions can be drawn?	—geoboard —elastics
E. Quadrilaterals The student should be able to: — **identify quadrilaterals according to the number of equal sides:** — **rectangle** — **square** — **parallelogram**	Identify these shapes in terms of sides, vertices, angles and their application in real objects.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
F. Polygons and Symmetry		
The student should be able to:		
– find the number of lines of symmetry in regular polygons: – equilateral triangle – square – pentagon – hexagon – octagon – decagon	Review symmetry from grade 5. How many lines of symmetry can be found in equilateral triangles, squares, pentagons, hexagons, octagons, decagons, etc.? What can be concluded about the circle? Searching for symmetry in the environment.	—polygonal models —beads —paper for folding —geopaper —pegboards —mirror
G. The Circle		
The student should be able to:		
– identify and name the parts of a circle: – centre – radius – diameter – circumference	Relationships may be discovered and explored by measurement of concrete objects. Have the pupils measure and record the diameter and the circumference for each object. Can any relationship be observed between the diameter and circumference of the objects? What is the relationship?	—string —calipers —ruler —measuring tape —jar lids —wheels
H. Congruence		
The student should be able to:		
– test two figures for congruence: 1. by tracing 2. by folding 3. using MIRA, etc.	Remembering that figures of the same size and shape are congruent, students may test for congruency by tracing and then matching: 1. in a set of similar shapes 2. in a set of shapes that have been flipped or turned  A B C SLIDE D E F X Y FLIP A B M TURN B A N C $\triangle ABC \cong \triangle DEF$ $\triangle X \cong \triangle Y$ $\triangle M \cong \triangle N$	—shapes (geometric) —tracing paper —transparent mirror (MIRA)
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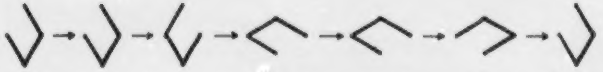
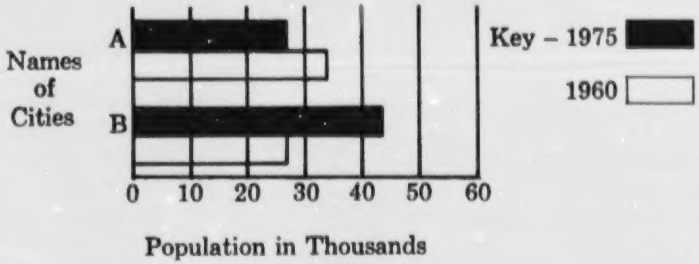
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
I. Motion Geometry		
The student should be able to:		
1. identify motions as slides, flips and turns	See sections on angles and congruence.	
2. indicate the position of a shape following a slide, flip, or turn	NOTE: Environmental objects can be observed and analyzed for congruency.	
3. test shapes for congruence after they have been slid, flipped, or turned, or by sliding, flipping or turning one shape onto another		
4. use a combination of slides, flips, and/or turns to create a pattern or design		
5. relate what has occurred (i.e., slide, flip, turn) when the position of a shape or the orientation of a pattern has changed	e.g., 	
XI. **GRAPHS**		
Introductory Note	Graphing has been introduced and developed through grades 1-5. The types of graphing already introduced are further developed in grade 6.	
	The only new type introduced is the circle graph and students are *not required to construct a circle graph* but only to have an understanding of the concept and be able to interpret simple circle graphs.	—graph paper —rulers
	Students should review the steps in graphing described fully in grade 4, section VI, and summarized in grade 5, section VII, and practice constructing and interpreting the various types of graphs.	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
Types of Graphs		
1. Concrete Graphs		
The student should be able to:		
— construct, interpret and report on a concrete graph	See grade 1.	
2. Pictograph		
The student should be able to:		
— construct, interpret and report on a pictograph	See grades 1-4.	—magazine cut-outs
3. Bar Graphs (Vertical or Horizontal)		
The student should be able to:		
a. select the scale for a bar graph	See grade 5.	
b. label the axes of a bar graph		
c. construct a bar graph	Students should be involved in selecting the scale and in labelling the axes. They should be exposed to vertical and horizontal forms of the bar graph. Twin bars may be used to make comparisons.	—graph paper —transparencies —overhead projector
d. interpret and report on the results illustrated on a bar graph	POPULATIONS OF CITIES  	

Concepts and Skills are indicated in Bold Face.

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
e. title the bar graph	Graphing situations may include: 1. population 2. precipitation (weather) 3. birthdays 4. probability	
4. Number Pairs (Ordered Pairs)		
The student should be able to:		
a. name the axes: **i. horizontal and vertical axes** **ii. X-axis and Y-axis**	See grade 5, section VII.	—geoboards and elastic bands —string —graph paper
b. label the points on the axes		
c. locate points (ordered pairs) on the graph	Practice is needed to attain proficiency with the stated objectives.	—games: "Battleship", "Vectors" —maps
d. describe points on a graph by naming the ordered pair which the point represents		
ENRICHMENT: Include other quadrants and work number pairs that include negative numbers.		
5. Line Graphs		
The student should be able to:		
— maintain and develop proficiency with constructing, interpreting and reporting on line graphs	Maintain and develop the students proficiency with line graphs.	
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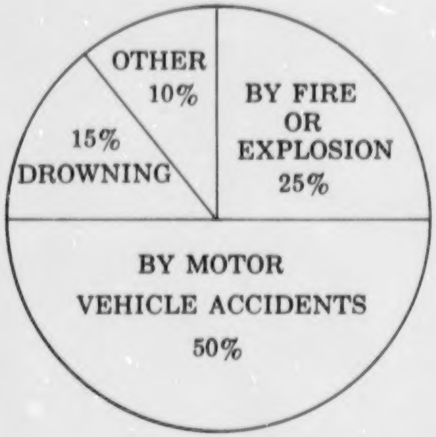
CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. Circle Graphs **The student should be able to:** **— interpret simple circle graphs**	When percentage data is given or determined, it may be illustrated by the circle graph where the circle represents 100%, half the circle is 50%, etc. e.g., CAUSES OF ACCIDENTAL DEATHS 	
XII. PROBLEM SOLVING **A. Oral Problems** The student should be able to:	Refer to notes on program implementation for further suggestions regarding problem solving. NOTE: See environmental activities at end.	
1. solve simple oral problems quickly and accurately 2. explain how he/she obtained the solution: a. using concrete materials b. using diagrams c. using a number sentence	Teacher-directed sessions should involve presentation and interpretation of a variety of simple problems. Visual representations should be explored. Number sentences should be considered. Students should also be given the opportunity to provide problem situations for given number sentences.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
B. Computational Problems		
The student should be able to:		
1. solve textbook problem exercises based on graphs, diagrams, pictures, descriptions, etc.	Most textbooks feature pages of "computational problems". One example features a graph at the top of the page along with a series of questions related to the graph. Questions involve both computation and reading from the graph.	—textbooks
2. explain how he/she obtained the solution		
C. Word Problems		
The student should be able to:		
1. solve one- and two-step word problems	The expectations involving word problems are outlined under headings related to basic operations with whole numbers, fractions, and decimals. NOTE: A three-step problem would be described as a problem requiring three successively different operations for its solution.	
2. analyze word problems	The following steps listed in the concepts, skills and objectives column are suggested as a guideline to solving word problems.	
D. Procedures for Solving Problems		
1. interpret the problem	This involves the recognition of the nature of the problem. A familiarity with the vocabulary will assist with the interpretation. By relating to past situations one may better understand the problem. Before proceeding to find the solution however, irrelevant material must be "sifted" out. This search for relevant information is a good exercise in teaching students how to approach a problem. Once a total picture is visualized through vocabulary, past situations, determining relevant information, and the use of concrete models, i.e., number lines, graphs, etc., the pupil is ready to decide on the procedure.	
2. illustrate the problem 621	Use concrete materials, representative materials, or draw a diagram to illustrate a problem.	622

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
3. decide the procedure for solving the problem and write the appropriate number sentence	Students should be encouraged to make mental operations. Simplifying the problem, looking for word clues (more, total, difference, etc.) and considering alternate methods will assist in making a decision. Once a decision is made the student should record the procedure in a number sentence. The teacher should be flexible, however, as far as format is concerned. Consider the alternatives: 1. Let n = the total number of students in class n = 14 + 12 n = 26 students The total number of students in class is 26. 2. n = 14 + 12 $\begin{array}{r} 14 \\ +\ 12 \\ \hline 26 \end{array}$ n = 26 students 3. Other variations should, however, include a number sentence. The number sentence should contain only numerical symbols (decimals included). Units (kilograms, persons, etc.) should not be contained in the number sentence. Where a problem contains more than one operation (step) the order of operations should be as follows: a. { [( )] } brackets — (inner parentheses — first); [square brackets — second] { braces — third.} b. +, —→ addition and subtraction in the order they occur. c. ×, ÷→ multiplication and division in the order they occur. NOTE: If no bracket indicated begin at step (b).	
4. estimate the solution	Performing the operation on rounded-off numbers will provide an estimated answer.	
5. perform the operations necessary to solve the problem	Using known mathematical skills and knowledge of concepts, perform the operation.	

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
6. check the solution	Check the solution against the estimated answer to determine its "reasonableness". By performing the inverse operation in many cases one can ascertain the accuracy of the solution.	
7. write the solution in statement form	Apply the proper unit to the numerical solution when necessary. A concluding statement may be added if desired. Refer back to the original question and determine whether or not the question has been answered.	

ENRICHMENT:

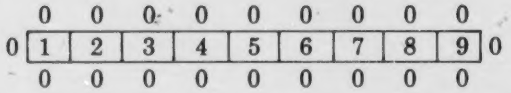
The student should be able to:

1. **solve problems or puzzles involving mathematical concepts and concepts from other various disciplines**

This usually includes challenging situations which can be found through application of materials, charts, graphs, patterns (sequences), etc. (Nim games, tangrams, paper folding, magic squares, geoboard constructions, number patterns, solids, etc.)

e.g., 20 students were invited to a birthday party at Maria's. Maria had several small tables that could seat one person on each side. She planned to place the tables end-to-end to make one long table to seat all the guests. How many tables did she need?

No. of tables	1	2	3	4	5	6	. . . 9 tables
No. of people	4	6	8	10			. . . 20 people



2. **make observations and draw resulting conclusions from activities and data related to mathematics methods, theorems, etc, (guided discovery)**

It is most important that the teacher consider some of the following recommendations for applying these problems to the classroom.

a. Provide a good number of open-ended problems along with problems requiring specific solutions.

b. Prepare *precise* directions (along with references) that will enable the students to interpret and solve problems independently.

(Cont'd)

CONCEPTS, SKILLS AND OBJECTIVES	TEACHER'S NOTES AND SUGGESTED ACTIVITIES	SUGGESTED MATERIALS
ENRICHMENT (cont'd):	c. Provide problems that will require student involvement with materials. These materials should be readily available to the student at the time he/she is working with the problem. d. The pupil should be required to illustrate his/her data via large graphs, diagrams, charts, computations, etc. This also provides the teacher with an opportunity to set adequate standards of presentation, i.e., correct graphing procedures, lettering (titles), measuring, etc. e. The teacher should supervise such activities carefully, interjecting with introspective questioning, i.e., do you see a pattern? What do you think the next number will be? f. Student's work should be displayed in the classroom and findings should be discussed within the class or with groups within the class.	

SUPPLEMENTARY MATERIALS

A. CHILDREN'S BIBLIOGRAPHY

The books listed have been selected to appeal to children's natural interests as well as to provide background in spatial relationships and early number concepts. Because this list is intended only as a sampling, some excellent books have not been included. If you have some old favourites, we hope you will continue using them. The particular mathematical concepts treated in each book have been noted.

GRADE LEVEL	PUBLICATION	COMMENTS
K-6	Asimov, Isaac. *How Did We Find Out About Numbers.* Walker & Co., 1973. (Canadian Publisher: Beaverbooks.)	
K-6	Burns, Marilyn. *The I Hate Mathematics Book.* Toronto: Little, Brown & Co. (Canada) Ltd., 1975.	
K-6	Caudill, Rebecca. *A Pocketful of Cricket.* Toronto: Holt, Rinehart and Winston of Canada Ltd., 1964.	number line
K-6	Elkin, Benjamin. *Six Foolish Fishermen.* Childrens Press, 1965. (Canadian Publisher: Scholars' Choice Ltd.)	cardinal numbers: counting and numerical order
3-4	Foster, L. *Macdonald Mathematics Series.* London, England: Macdonald and Company Ltd., 1974.	A series of booklets for student reading in mathematics concepts. Titles of booklets: Kitchen Maths; Garage Maths; Circus Maths; Seaside Maths; Toyship Maths; Playground Maths; Farm Maths; Building Maths; Clothes Maths; Going Places Maths.
K-6	Friskey, Margaret. *Seven Diving Ducks.* Childrens Press, 1965. (Canadian Publisher: Scholars' Choice Ltd.)	ordinal numbers: counting and numerical order
K-6	Geisel, Theodor S. *One Fish, Two Fish, Red Fish, Blue Fish.* Mississauga: Random House of Canada Limited, 1960.	one-to-one correspondence: counting and numerical order

GRADE LEVEL	PUBLICATION	COMMENTS
K-6	Hoban, Russell. *Bedtime For Frances.* Harper & Row, 1960. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	time
K-6	Holt, Michael. *Maps, Tracks, and the Bridges of Konigsberg.* Thomas Y. Crowell Co., 1975. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	graphing
K-6	Ipcar, Dahlov. *Brown Cow Farm.* Toronto: Doubleday Canada Ltd., 1959.	multiples and pairs
K-6	Lionni, Leo. *Inch by Inch.* New York: Astor-Honor Inc., 1960.	measurement
3-6	Mold, J. *Topics From Mathematics.* England: Cambridge University Press, 1969.	A series of booklets for student reading in mathematics concepts. Titles of booklets: Tessellations; Toward Probability; Triangles; Solid Models; Squares; Rolling; etc.
K-6	Schimel, W. and Luce, M. *Math Concept Series.* Lerner Publications, 1969. (Canadian Publisher: J. M. Dent and Sons (Canada) Ltd.)	A series of booklets for student reading in mathematics concepts. Titles of booklets: Infinity—What Is It?; Measurement—How Much? How Many? How Far?; One Is Unique; Patterns—What Are They?; Polygons—Points In A Plane; Primes Are Builders; Sets—What Are They?; Zero is Something; Counting Systems—The Familiar and the Unusual; Polyhedrons—Interesting Planes; Points, Lines, and Planes; Ten, Why Is It Important?
K-6	Selden, George. *Sparrow Socks.* Harper & Row, 1964. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	large numbers: multiples and pairs
K-6	Ungerer, Tomi. *Snail, Where Are You?* Harper & Row, 1962. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	patterns and shapes
K-6	Weiss, Malcolm E. *666 Jellybeans!* Thomas Y. Crowell Co., 1976. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	simple introduction to algebra
K-6	Wildsmith, Brian. *Brian Wildsmith's 1, 2, 3's.* Franklin Watts Inc., 1965. (Canadian Publisher: Grolier Limited.)	counting and numerical order

B. TEACHER REFERENCES

GRADE LEVEL	PUBLICATION	COMMENTS
K-6	Beggs, E. E. and MacLean, J. R. *Freedom to Learn: An Active Learning Approach to Mathematics.* Don Mills: Addison-Wesley (Canada) Ltd., 1969.	A learning approach involving active learning, discovery methods, and laboratory approach.
K-6	Council of Ministers of Education of Canada. *Metric Style Guide.* Toronto: Council of Ministers of Education of Canada, 1975.	This publication deals with the correct style to be used in expressing metric terms, units of measure, and their symbols. An explanation as to what each unit represents and how it is to be used in real-life situations is included. The guide details the approved standards for use by Canadians as Canada adopts the modernized (SI) metric system.
K-8	Henderson, G. L. and Glunn, L. *Let's Play Games in Mathematics.* Toronto: Copp Clark Publishing, 1974.	A set of nine booklets of simple games—one for each level K-8.
K-6	Hill, J. M. (Editor.) *The Arithmetic Teacher.* Reston: The National Council of Teachers of Mathematics.	A very useful journal written for elementary school teachers and published eight times a year. Subscription price includes membership in the Council.
3-6	Laycock, M. and Watson, G. *The Fabric of Mathematics.* Activity Resources Company, 1975. (Canadian Publisher: Cahl's Inc.)	This invaluable resource book for teachers is divided into five sections—number, numeration, measurement, geometry, sets and logic. Each strand has behavioural objectives and activities. Commercial manipulatives, games, activities, audio-visual materials and references for both children and teachers are listed.
4-10	O'Daffer, P. and Clemens, S. *Geometry: An Investigative Approach.* Don Mills: Addison-Wesley (Canada) Ltd., 1976.	A reference for teachers of geometry at all levels stressing the nature of geometry using the discovery approach and keeping in mind sound pedagogical techniques. Many ideas are new and not a rehash of previous experiences in high school geometry. Topics include polyhedra, tessellations, motion geometry, topology, similarity, number patterns, and measurement using metric units.
K-6	Payne, J. N. (Editor.) *Mathematics Learning In Early Childhood.* Reston: The National Council of Teachers of Mathematics, 1975.	This is from the thirty-seventh yearbook of the National Council of Teachers of Mathematics.

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GRADE LEVEL	PUBLICATION	COMMENTS
K-6	The School's Council. *Mathematics in Primary Schools: Curriculum Bulletin #1*. Her Majesty's Stationery Office, 1966. (Canadian Publisher: Pendragon House Ltd.)	The materials in this bulletin cover a wide area. The aim of the bulletin is to provide the philosophy for changes referred to and also to provide teacher support material.

C. TEACHER RESOURCES

GRADE LEVEL	PUBLICATION	COMMENTS
4-6	Adler, J. *The Giant Golden Book of Mathematics (Exploring Worlds of Numbers Space)*. The Golden Press, 1960. (Canadian Publisher: Scholars' Choice Ltd.)	This book provides an interesting look into the history and development of numbers geometry.
K-2	Baratta-Larton, M. *Mathematics Their Way*. Don Mills: Addison-Wesley (Canada) Ltd., 1976.	This book expands the activity-centred philosophy of *Workjobs* through grades 1 and 2. It is a useful resource book for primary teachers.
K	Baratta-Larton, M. *Workjobs*. Don Mills: Addison-Wesley (Canada) Ltd., 1972.	This is an activity-centred approach to learning for early childhood education and is a useful resource for kindergarten teachers.
4-6	Baratta-Larton, R. *Mathematics — A Way of Thinking*. Don Mills: Addison-Wesley (Canada) Ltd., 1977.	A series of activities designed at a lower level of mathematical sophistication. The series is possibly useful for all students, but more especially for those students progressing more slowly than average.
4-8	Barnett, C. *Metric Ease*. Creative Publications, 1975. (Canadian Publisher: Edu-Media.)	Contains various metric measurement activities.
1-8	Bates, W. W. et al. *Math Action Books 1-8*. Toronto: Copp Clark Publishing, 1973.	A collection of activities and games which provide another alternative to worksheets as a means of drill. Could be used as a motivational aspect. Math Action Activity Cards have been metricated for books 1, 2 and 3.
3-5	Bell, S. E. *Patterns of Mathematics, Books 1-14*. Don Mills: Longman Canada Limited, 1969.	A series of simplified explanations of various mathematical concepts.

GRADE LEVEL	PUBLICATION	COMMENTS
1-6	Brands, Robert E. *Tangletable*. Creative Publications, 1973. (Canadian Publisher: Edu-Media.)	Includes worksheets coded re difficulty; tables, puzzles and formats for addition and multiplication.
3-6	Branley, F. M. *Think Metric*. Thomas Y. Crowell Co., 1972. (Canadian Publisher: Fitzhenry & Whiteside Ltd.)	A book for students relating the history of measurement and the logical development of the metric system.
3-4	Briten, P. *Clearway Maths*. Don Mills: Oxford University Press, 1977.	A varied approach to practice the four operations. A supplement to any maths course. Titles of the four books are: Book 1—Addition; Book 2—Subtraction; Book 3—Multiplication; Book 4—Division.
5-6	Brydegaard, M. and Inskeep, J. (Editors.) "Readings in Geometry". Reston: The National Council of Teachers of Mathematics, 1970.	Excerpts from *The Arithmetic Teacher* and other resources regarding various topics within the field of geometry.
4-8	Cordin, P. W. *Mathematics and Metric Measuring*. London, England: MacMillan Education Ltd., 1973.	This series provides a variety of "workshop" activities dealing with measurement and other related concepts. Six booklets: Measuring Length; Measuring Weight; Measuring Time; Measuring Quantity; Measuring Area; Measuring Volume.
4-6	Del Grande, J. *Geoboards and Motion Geometry For Elementary Teachers*. Don Mills: Fitzhenry & Whiteside Ltd., 1972.	A collection of exploratory-type geoboard activities for early grades.
K-6	Department of Education. *Idea Bank of Consumer Education Learning Activities for K-6*. Winnipeg: Department of Education, 1977.	A compilation of material geared to consumer applications—many of which are related to mathematics at the elementary level. The idea bank was assembled at the Manitoba Department of Education and copies were placed in every elementary school in Manitoba.
K-3	Farril, M. *Geoboard Geometry*. Creative Publications, 1977. (Canadian Publisher: Edu-Media.)	A collection of exploratory-type geoboard activities for early grades.
K-3	Forte, I. and McKenzie, J. *Creative Math Experiences for the Young Child*. Incentive Publications, Inc. (Kidstuff Series), 1973. (Canadian Publisher: Moyer Vico Corp.)	A collection of activities for mathematics in the early years of school.

GRADE LEVEL	PUBLICATION	COMMENTS
1-3	Forte, I., Pangle M. A. and Tupa, R. *Centre Stuff for Nooks, Cranies and Corners.* Incentive Publications, Inc. (Kidstuff Series), 1973. (Canadian Publisher: Moyer Vico Corp.)	A collection of integrated activities for several subject areas including mathematics.
1-6	Frank, M. *Kid Stuff Math.* Incentive Publications, Inc. (Kidstuff Series), 1974. (Canadian Publisher: Moyer Vico Corp.)	Contains a supply of activities and games for the classroom mathematics learning centres. The activities are related to specific mathematics concepts or topics.
1-7	Golick, Margie. *Deal Me In.* Jeffery Norton Publishers, Inc., 1973. (Available from: The Teachers Store.)	A collection of card games played with an ordinary deck of cards and designed to develop and reinforce mathematics concepts, to develop proper eye movements, to develop terminology, etc.
2-6	Grimm, G. and Mitchell, D. *The Good Apple Math Book.* Edmonton: Western Educational Activities, 1976.	Ideas and activities for math centres.
3-6	Henderson, Martin. *Strikesville.* Toronto: Copp Clark Publishing, 1975.	Duplicating masters to reinforce basic skills.
4-7	Hestwood, D., Orf, E. and Huseby, E. *Cross Number Puzzles: Book 1—Whole Number Operations.* Creative Publications, 1972. (Canadian Publisher: Edu-Media.)	This book gives practice in basic computational skills. Each puzzle is keyed to a definite objective.
3-8	Higgins, J. L. (Editor.) *A Metric Handbook for Teachers.* Reston: The National Council of Teachers of Mathematics, 1974.	Representative topics on metric system from *The Arithmetic Teacher* and other sources.
K-12	Hull, William P. (Editor.) *Attribute Games and Problems.* Scarborough: McGraw-Hill Ryerson Limited, 1968.	To develop thinking skills. Activities with classification, logical relationships between attributes and properties of sets.
4-6	Jackson et al. *Modern Mental Mathematics.* Agincourt: The Book Society of Canada Limited, 1972.	A collection of mental mathematics exercises for intermediate school students.
1-6	Jones et al. *Sydney Cylinders Mathlab.* Stratford: Scholars' Choice Ltd., 1972.	activity kit
3-5	Judd, W. *Patterns to Play on a Hundred Chart.* Creative Publications, 1975. (Canadian Publisher: Edu-Media.)	Comprised of forty-four patterns that can be generated on a hundred chart.

GRADE LEVEL	PUBLICATION	COMMENTS
3-8	Kahn, C. and Hanna, J. B. *Pacemaker Practical Arithmetic Series.* Toronto: Copp Clark Publishing, 1977.	A series designed to illustrate the need for money and provide a variety of exercises and activities to develop understanding of and proficiency in the use of money. Also relevant beyond the elementary school levels. Titles in series: Money Makes Sense; Using Dollars and Sense; Working Makes Sense.
1-4	Karl, M. K. et al. *Drillsville.* Toronto: Copp Clark Publishing, 1975.	Games and activities for mathematics skills development. In duplicating master format.
1-2	Lawless, Hammell and Packard. *Numbers and Numerals In Action (Metricated Edition, Books 1 and 2).* Toronto: Copp Clark Publishing, 1974.	A book of activities.
1-8	Le Blanc, J. et al. *Mathematics Methods Program.* Indiana University Project, 1976. (Canadian Publisher: Addison-Wesley (Canada) Ltd.)	A series of teacher education units offering the teacher alternate approaches and additional background in the various fields of mathematics. Titles in series: Numeration; Addition and Subtraction; Multiplication and Division; Number Theory; Rational Numbers; Experiences in Problem Solving; Measurement; Graphs; Awareness Geometry; Analysis of Shapes; Transformational Geometry; Probability and Statistics.
K-4	Lettau, J. H. *Time Marches On.* Edmonton: Western Educational Activities, 1976.	Suitable for introducing time in K-2 or remedial work in 3-4.
1-6	Long, R. *Purpose Puzzles.* Toronto: Copp Clark Publishing, 1973.	Cross number puzzles with specific objectives for individualizing or enriching mathematics.
4-8	Marcy, S. and Marcy, J. *Addition and Subtraction With a Happy Ending.* Creative Publications, 1976. (Canadian Publisher: Edu-Media.)	An enrichment book to provide practice in the basic skills of addition and subtraction.
4-6	Marcy, S. and Marcy, J. *Mathimagination.* Creative Publications, 1973. (Canadian Publisher: Edu-Media.)	Published as six separate booklets (A-F) or as a complete kit in a loose-leaf binder. Provides practice in basic skills through a variety of interesting puzzles and activities.

GRADE LEVEL	PUBLICATION	COMMENTS
2-6	Metzner, S. *55 Metric Games for the Elementary Grades*. Toronto: Copp Clark Publishing, 1976.	A collection of games.
4-6	MIRA Math Company. *MIRA Activities for the Elementary School.* MIRA Math Company, 1973. (Available from: Moyer Vico Corp. or Edu-Media.)	A discovery-type approach for elementary grades detailing the use of the "MIRA" as a means of introducing and developing motion geometry concepts.
1-8	Mutart, A. et al. *Check and Double Check*. Stratford: Scholars' Choice Ltd., 1976.	A metricated series of graded workbooks with many ideas useful to teachers.
K-8	Nelson, L. D. and Sawyer, W. W. *Mathex*. Toronto: Encyclopaedia Britannica Publications Ltd., 1969.	A large collection of discovery or laboratory-type activities for all grade levels K-8.
1-6	Opper, J. W. et al. *Mathlab*. Stratford: Scholars' Choice Ltd., 1975.	activity kit
1-4	Parsens, J. W. *Math-A-Dot*. Toronto: Copp Clark Publishing, 1975.	books of learning games
2-6	Pasternack, M. and Silvey, L. *Pattern Block Activities, Book A*. Creative Publications, 1975. (Canadian Publisher: Edu-Media.)	Contains activities for fractions, geometry, area and perimeter.
4-6	Price, S. S. and Price, M. E. *Projects in Metric Measurement*. Stratford: Scholars' Choice Ltd., 1974.	collection of activities
4-8	Routledge, J. *Mathemetrics Books 1-5*. Agincourt: The Book Society of Canada Limited, 1975.	This series provides a variety of activities for metric measurement.
2-6	Rucker, W. and Dilley, C. *Math Card Games*. Creative Publications, 1974. (Canadian Publisher: Edu-Media.)	Includes six categories of games. The major concept is indicated for each game. Provides drill and practice.
1-6	Saunders, J. G. *Metric Math*. Don Mills: Thomas Nelson & Sons (Canada) Ltd., 1971.	A series of four modules on various aspects of metric measurement.
1-12	Schadler, S. *Pic-A-Puzzle*. Creative Publications, 1970. (Canadian Publisher: Edu-Media.)	Illustrates how teachers and students can create puzzle designs of their own.
5-6	Seymour, D. et al. *Aftermath Series, Books 1-4*. Creative Publications, 1970. (Canadian Publisher: Edu-Media.)	A series of enrichment activities to reinforce aspects of the curriculum and introduce new aspects to mathematics. Contains cartoons, humour, designs, puzzles, codes and games.
1-3	Sharp, R. and Metzner, S. *Magic Squares Level A*. Downsview: Charles E. Merrill Publishing, 1972.	Forty magic squares in addition and subtraction. Good for grade 1 and up.

GRADE LEVEL	PUBLICATION	COMMENTS
K-9	Silvey, L. and Pasternack, M. *Pattern Blocks Coloring Book.* Creative Publications, 1974. (Canadian Publisher: Edu-Media.)	Contains a wide variety of shapes and patterns for colouring.
4-6	Smith, D. E. *History of Mathematics, Volumes I and II.* Dover Publications Inc., 1958. (Canadian Publisher: General Publishing Co. Limited.)	Volume I treats the history of math as "a non-technical chronological survey." Volume II traces the evolution of the various branches of mathematics. This is a good teacher reference.
4-6	Smith, D. E. and Ginsberg, J. *Number, Stories of Long Ago.* Reston: The National Council of Teachers of Mathematics, 1969.	Classic stories on the history of mathematics.
5-6	Smith, D. E. and Ginsberg, J. *Numbers and Numerals.* Reston: The National Council of Teachers of Mathematics, 1937.	An historical account on the development of numeration systems.
1-6	Smith, S. E. and Backman, C. A. *Teacher-Made Aids for Elementary School Mathematics.* Reston: The National Council of Teachers of Mathematics, 1974.	Excerpts from *The Arithmetic Teacher* and other sources. The book provides the teacher with a supply of good ideas for teacher-made materials.
4-8	Stonaker, F. B. *Famous Mathematicians.* Toronto: J. B. Lippincott Company of Canada Ltd., 1966.	This is an interesting book containing anecdotal sequences in the lives of such mathematicians as Euclid, Archimede, Gauss, etc. This is a good book to read to children.
3-6	Swartz, C. and Gardner, H. *Measurement Concepts and Applications, Books 1, 2, 3.* Markham: Houghton Mifflin Canada Ltd., 1975.	Science activities applying metric measurement.
3-6	Thomason, M. E. *Modern Math Games, Activities and Puzzles.* Toronto: Copp Clark Publishing, 1970.	A collection of games and activities.
2-4	Wernecke, E. *School House 1 & 2.* Willowdale: Science Research Associates (Canada) Ltd., 1977.	activity kits
1-4	Wiley, B. M. *Time and Telling Time.* Toronto: Copp Clark Publishing, 1967.	A reasonably complete course in telling time on a 12-hour clock. Reading level up to 2.9.
2-6	Zullie, M. *Fractions With Pattern Blocks.* Creative Publications, 1975. (Canadian Publisher: Edu-Media.)	An illustrated approach to the understanding of fractions.

APPROVED TEXTBOOKS K-6

1. Starting Points in Mathematics. Ginn, 1977.

    Book 1 — Grade 1
    Book 2 — Grade 2
    Book 3 — Grade 3

2. Heath Elementary Mathematics—Canadian Edition. D. C. Heath, 1972.

    Book 4 — Grade 4
    Book 5 — Grade 5
    Book 6 — Grade 6

3. Investigating School Mathematics Series. Addison-Wesley, 1973.

    Investigating School Mathematics Primer
    Investigating School Mathematics Book 1
    Investigating School Mathematics Book 2
    Investigating School Mathematics Book 3
    Investigating School Mathematics Book 4
    Investigating School Mathematics Book 5
    Investigating School Mathematics Book 6

4. Mathways Program. Copp Clark, 1974.

    Book 1 — Grade 1
    Book 2 — Grade 2
    Book 3 — Grade 3

5. Project Mathematics Series SI Metric. Holt, Rinehart and Winston, 1975.

    Project Mathematics SI Metric Book 1
    Project Mathematics SI Metric Book 2
    Project Mathematics SI Metric Book 3
    Project Mathematics SI Metric Book 4
    Project Mathematics SI Metric Book 5
    Project Mathematics SI Metric Book 6

6. SRA Mathematics Learning System. SRA, 1975.

    Level 4 Text
    Practice Sheets
    Level 5 Text
    Practice Sheets
    Level 6 Text
    Practice Sheets

NOTE: The list of Approved Textbooks may change from year to year as new textual series are added or as old ones are deleted. Therefore, teachers are requested to check the current Manitoba Textbook Bureau Catalogue for up-to-date listings.

SUPPLEMENTARY MATERIALS

Books

Education Library (see catalogue)
Main Floor — 1181 Portage Avenue
Winnipeg, Manitoba
R3G 0T3
Phone: 786-0221

Audio-Visual

1. School Film Services (see catalogue)
    214 A — 1181 Portage Avenue
    Winnipeg, Manitoba
    R3G 0T3
    Phone: 786-0222

2. School Broadcasts (see catalogue)
    214 — 1181 Portage Avenue
    Winnipeg, Manitoba
    R3G 0T3
    Phone: 786-0225

3. Education Library
    Main Floor — 1181 Portage Avenue
    Winnipeg, Manitoba
    R3G 0T3
    Phone: 786-0221

All of the above may be reached via the toll free Wats Line 1-800-262-8848.